MOFFETT FEDERAL AIRFIELD
FINAL OPERABLE UNIT 5
RECORD OF DECISION

(Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act)

June 28, 1996

Issued By:

U.S. Department of Navy - Engineering Field Activity West
Naval Facilities Engineering Command

and

U.S. Environmental Protection Agency
Region 9 - San Francisco, California

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ACRONYMS AND ABBREVIATIONS

APEN	Air pollution emission notice
ARAR	Applicable or relevant and appropriate requirements
AS	Air sparging
BAAQMD	Bay Area Air Quality Management District
BAT	Best available technology
BCT	Best conventional control technology
bls	Below land surface
BRAC	Base realignment and closure
Cal EPA	California Environmental Protection Agency
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action Navy
COC	Chemical of concern
COPC	Chemical of potential concern
CRP	Community relations plan
CRQL	Contract required quantitation limit
CSF	Carcinogenic slope factor
DTSC	Department of Toxic Substances Control
EPA	Environmental Protection Agency
FFA	Federal facilities agreement
FS	Feasibility study
gpd	Gallons per day
gpm	Gallons per minute
HHRA	Human health risk assessment
HSP	Health and safety plan
HTA	Heavier than air
IAS	Initial assessment study
IRP	Installation restoration program
LEC	Lowest effect concentration
LTA	Lighter than air
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
MEW	Middlefield-Ellis-Whisman
MODFLOW	Model for groundwater flow
MODPATH	Model for particle tracking post processing
msl	Mean sea level
MT3D	Model for contaminant fate and transport

ACRONYMS AND ABBREVIATIONS (Continued)

NASA	National Aeronautics and Space Administration
NASMF	Naval Air Station Moffett Field
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and maintenance
OU	Operable unit
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyl
POTW	Publicly owned treatment works
PRC	PRC Environmental Management, Inc.
RA	Remedial action
RAB	Restoration Advisory Board
RAO	Remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
ROD	Record of decision
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SCVWD	Santa Clara Valley Water District
SMCL	Secondary maximum contaminant level
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
SWEA	Sitewide ecological assessment
SWRCB	State Water Resources Control Board
TAG	Technical assistance grant
TCE	Trichloroethene
TDS	Total dissolved solids
TRC	Technical review committee
TSD	Treatment, storage, or disposal
USFWS	U.S. Fish and Wildlife Service
UST	Underground storage tank
UV	Ultraviolet
VOC	Volatile organic compound
WQC	Water quality criteria

DECLARATION STATEMENT FOR OPERABLE UNIT 5

Site Name and Location

Moffett Federal Airfield (formerly Naval Air Station Moffett Field)
Mountain View, California

This facility is on the National Priorities List (NPL). In 1991, Moffett Federal Airfield (Moffett Field) was designated for closure as an active military base under the Department of Defense Base Realignment and Closure (BRAC) program. Control of base operations was transferred to the National Aeronautics and Space Administration (NASA) on July 1, 1994.

Statement of Basis and Purpose

This decision document presents the selected remedial action — groundwater extraction, treatment of the water using air stripping, and discharge — for Operable Unit 5 (OU5) at Moffett Field in Mountain View, California. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local publicly owned treatment works (POTW) or local off-site surface waters under an NPDES permit. The remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is supported by information contained in the administrative record for this site. The U.S. Environmental Protection Agency (EPA) and the State of California concur with the selected remedy.

Assessment of the Site

OU5 consists of the aquifers of Moffett Field not affected by the regional volatile organic compound (VOC) plume. OU5 is located on the eastern side of Moffett Field. The chemicals of concern (COCs) within the southern plume of OU5 are 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride. Actual or threatened releases of these COCs from OU5, if not addressed by implementing the response action selected in this record of decision (ROD), may present a current or potential threat to public health, welfare, or

the environment. The area that is targeted for treatment is the southern plume at OU5. There is no action required for the northern plume, except groundwater monitoring, because the groundwater does not satisfy the state's criteria as a potential drinking water source and poses no unacceptable risk to human health or the environment.

Description of the Selected Remedy

Twenty-four sites have been identified at Moffett Field. This ROD selects the remedy for OU5 which consists of groundwater beneath Sites 3, 4, 5, 6, 7, 10, 11, 13, 15, 19, 21, 22, 23, and 24 on the eastern side of Moffett Field. The remaining 10 sites are being investigated as part of other OUs or the station-wide investigation. Some of the activities that are being conducted at Moffett Field are source control measures for Site 9 and west-side aquifers, stormwater and sanitary sewer actions, and soils remediation through corrective measures for petroleum contaminated sites. These activities are concurrent. Therefore, the Navy is coordinating all investigations, remedial designs, and schedules to provide an overall basewide management strategy.

The major components of the selected remedy for the southern plume of OU5 include the following:

- Groundwater monitoring
- Institutional controls - Fencing of the treatment system area, operation and maintenance of Building 191 and storm drainage system, and domestic use restrictions on the groundwater at OU5.
- Extraction and treatment of groundwater using an air stripping system followed by discharge. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.

No action is required (except for groundwater monitoring) for the northern plume.

Selection of the remedy for OU5 is consistent with overall remedial investigation and feasibility study (RI/FS) activities at Moffett Field. The U.S. Department of the Navy, the EPA Region IX, and the California Environmental Protection Agency (Cal EPA) concur that the selected remedy is an effective method for remediating contaminated groundwater at OU5.

Declaration Statement

Based on the evaluation of analytical data and other information, the Navy, EPA Region IX, and Cal EPA have determined that the selected remedy described above is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy uses permanent solutions and alternative treatment or resource recovery technologies and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Stephen G. Chao
BRAC Environmental Coordinator
Navy EFA-West

6/26/96
Date

Acting Director Federal Facilities Cleanup Office
EPA Region IX

6/28/96
Date

Anthony J. Landis
Chief of Operations, Office of Military Facilities
Department of Toxic Substances Control, Cal EPA

6-27-96
Date

Loretta Barsamian
Executive Officer
San Francisco Bay Regional Water Quality Control Board

6/27/96
Date

1.0 DECISION SUMMARY FOR OPERABLE UNIT 5

This section summarizes information regarding site description and history, community participation, scope and role of the response action at operable unit 5 (OU5), site characteristics and risks, and explanation of significant changes.

1.1 SITE NAME, LOCATION, AND DESCRIPTION

Moffett Federal Airfield (Moffett Field) is located near the southwestern edge of San Francisco Bay in Santa Clara County, California (Figure 1). The address of the facility is:

Moffett Federal Airfield
Moffett Field, California 94035

Moffett Field is bounded by salt evaporation ponds to the north, Stevens Creek to the west, U.S. Highway 101 to the south, and Lockheed Missile and Space Company's Lockheed Aerospace Center (Lockheed) to the east. The cities of Sunnyvale and Mountain View are adjacent to the southern portion of Moffett Field. The National Aeronautics and Space Administration (NASA) Ames Research Center is located to the west and north of Moffett Field.

Ground surface elevations at Moffett Field range from approximately 36 feet above mean sea level (msl) to 2 feet below msl. A sizable portion of Moffett Field is situated on previously submerged land or marshlands that have been filled to their existing elevations with backfill material.

Wetlands located along the northern portion of Moffett Field are the only natural surface water features at the base. The wetlands on Moffett Field are approximately 80 acres in size; about half of this area is below sea level. The portion above sea level is a critical habitat for a variety of mammals and birds. Approximately 1 mile beyond the northern boundary of Moffett Field is the San Francisco Bay. San Francisco Bay is California's largest estuary. There are no streams on Moffett Field, although several streams are present to the east and west. Coyote Creek and Guadalupe Slough drain into San Francisco Bay to the east of Moffett Field, and Stevens Creek drains into the San Francisco Bay to the west. The large area to the north and northeast of Moffett Field was diked and is now used as commercial salt evaporation ponds. Diked stormwater retention ponds also are present north and northwest of the station. No other surface water features are present at Moffett Field, with the

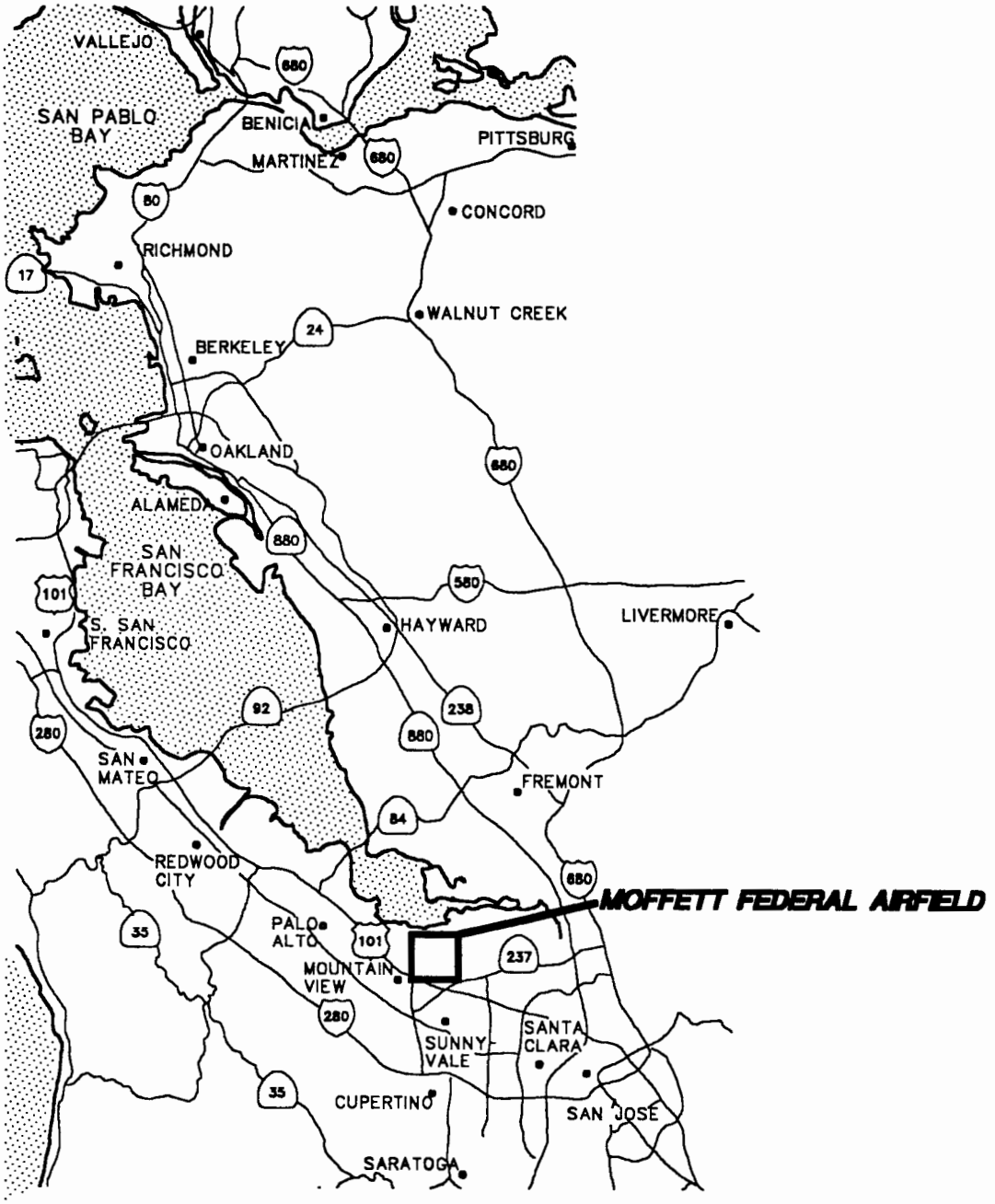

FIGURE 1
MOFFETT FEDERAL AIRFIELD
OU5 RECORD OF DECISION
REGIONAL LOCATION MAP

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exceptions of several small ponds maintained on the Moffett Field golf course as water hazards, stormwater drainage ditches, standing water after floodings or rainfall, and the wetlands described above.

The northern Santa Clara Valley groundwater basin is part of the down-dropped structural trough lying between the San Andreas and Hayward Faults. The erosion of the uplifted Santa Cruz Mountains has contributed sediment that has been transported by northward-flowing streams. Moffett Field lies on the San Jose alluvial plain near the toe of alluvial fans emanating from the Santa Cruz Mountains. On a regional scale, the overall sediment grain size becomes finer northward away from the mountains. On a local scale, alluvial processes have juxtaposed clay, silt, sand, and gravel in adjacent depositional environments.

The subsurface sediments below Moffett Field are classified as the A, B, and C aquifers. Figure 2 depicts a conceptualized cross section of the hydrogeology at Moffett Field. Aquifer materials within OU5 are composed primarily of interbedded silt, silty clay, and silty sand, with some sand and gravel channels of limited extent.

The A aquifer is divided into two aquifer zones: a shallow 5- to 35-foot deep zone referred to as the A1-aquifer zone, and a deeper 35- to 50-foot deep zone referred to as the A2-aquifer zone.

The Moffett Field storm drainage system has an effect on the flow direction and velocity of A1-aquifer zone groundwater at OU5. In the vicinity of OU5, the system includes the runway subdrains, Marriage Road, Patrol Road, and Navy ditches, and the Building 191 lift station. The Navy ditch penetrates deepest into the A1-aquifer zone and, therefore, probably has the greatest effect on the A1-zone groundwater. Continuing operation of the storm drainage system not only affects the A1-aquifer groundwater but also is important to control surface runoff and minimize surface flooding in the OU5 area.

A confining layer (A/B aquitard) separates the permeable deposits of the B aquifer from the channels of the A aquifer. The lithologies of the B aquifer sediments are similar in kind and distribution to the lithologies found in the A aquifer. At OU5, the A aquifer is generally semiconfined to confined and the B aquifer is confined.

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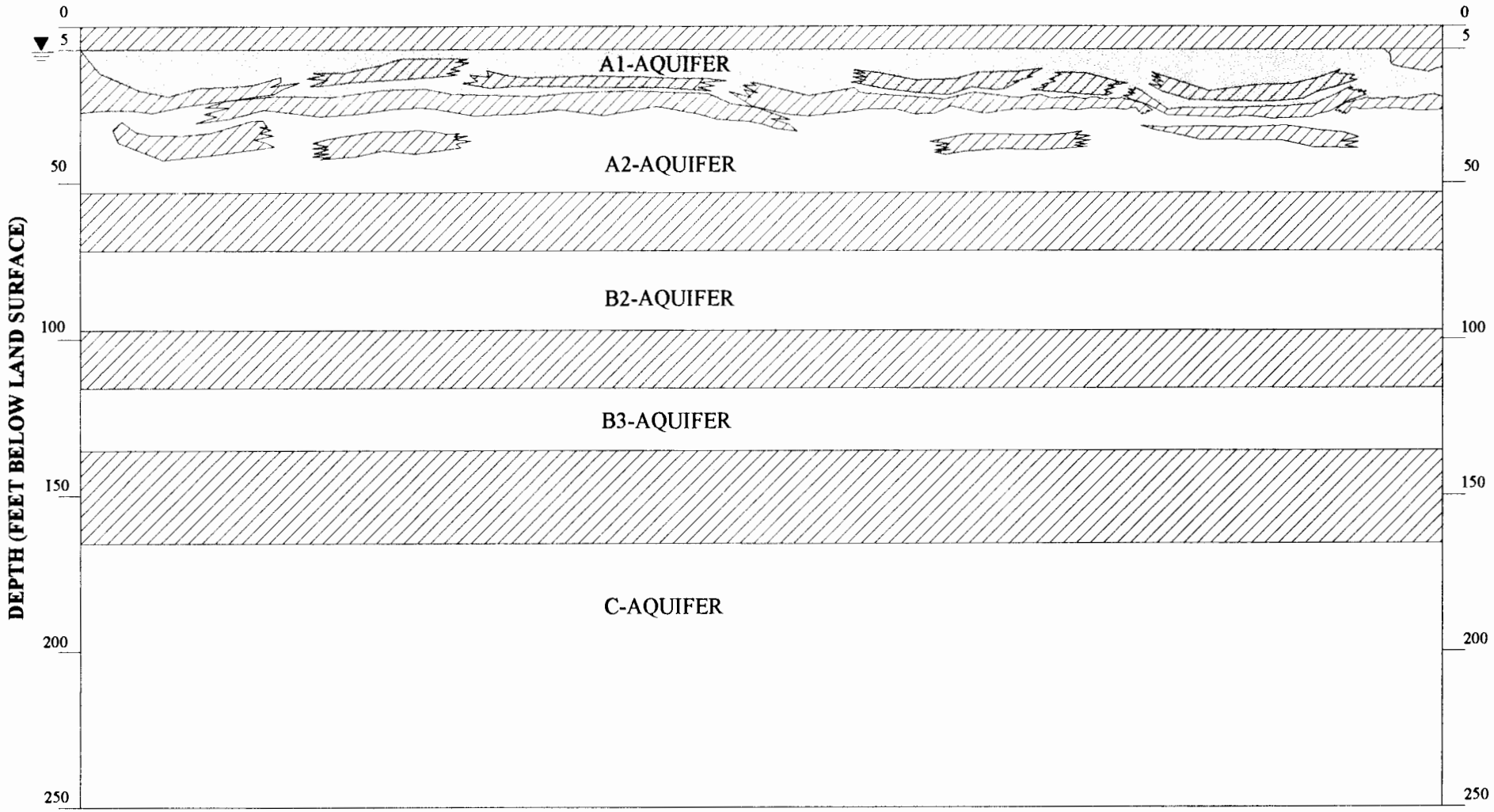


FIGURE 2
MOFFETT FEDERAL AIRFIELD
OU5 RECORD OF DECISION
CONCEPTUAL CROSS SECTION OF HYDROLOGY

The C aquifer is confined under a laterally extensive clay aquitard (B/C aquitard) that is present beneath Moffett Field between depths of 130 and 160 feet below land surface (bls). The B/C aquitard is a thick, laterally continuous aquitard and the vertical hydraulic gradient is directed upward between the C aquifer and overlying aquifers.

The A and B aquifers are not presently used. The C aquifer, however, is used as a source of municipal drinking water for the nearby communities of Mountain View and Sunnyvale and for irrigation purposes. None of the active municipal supply or agricultural supply wells are located at Moffett Field.

The groundwater flow direction in the A and B aquifers is generally northward toward San Francisco Bay, which is similar to the topographic surface. In the C aquifer, the flow direction is northeast. With the exception of the northern portion of the A aquifer, the aquifers at Moffett Field (A, B, and C) meet the State Water Resources Control Board (SWRCB) criteria for sources of drinking water (SWRCB Resolution 88-63). Therefore, the southern portion of the A, B, and C aquifers at Moffett Field are considered potential drinking water sources.

1.2 SITE HISTORY AND SUMMARY OF ENFORCEMENT ACTIVITIES

Moffett Field was continuously operated by the U.S. military after it was commissioned in 1933 to support the West Coast dirigibles (blimps) of the lighter-than-air (LTA) program until 1994. In 1935, the station was transferred to the U.S. Army Air Corps, which used it for training purposes. In 1939, a permit was granted to Ames Aeronautical Laboratory to use part of the station.

In 1942, the station was returned to Navy control and was named Naval Air Station Moffett Field (NASMF). In late 1942, the heavier-than-air (HTA) program was initiated and began to take precedence over the LTA program. In 1945, the HTA program was moved to Half Moon Bay Field and Moffett Field was used as a major overhaul and repair base. The LTA program was discontinued at Moffett Field in 1947. In 1949, the station became home to the Military Air Transport Service Squadron.

By 1950, Moffett Field was the largest naval air transport base on the West Coast and became the first all-weather naval air station. In 1953, the station became home to all Navy fixed-wing, land-based antisubmarine efforts. A weapons department was formed on the base in 1954, and in

February 1966 the base activated its high-speed refueling facilities. During the station reorganization in 1973, it became the headquarters of the Commander Patrol Wings, U.S. Pacific Fleet.

During the 1980s and early 1990s, the mission of Moffett Field was to support antisubmarine warfare training and patrol squadrons. The station supported more than 70 tenant units, including the Commander Patrol Wings, U.S. Pacific Fleet, and the California Air National Guard. Moffett Field was the largest P-3 Orion patrol aircraft base in the world, with nearly 100 aircraft. These aircraft were assigned to nine squadrons supported by 5,500 military, 1,500 civilian, and 1,000 reservist personnel. No heavy manufacturing or major aircraft maintenance was conducted at Moffett Field, but a significant amount of unit- and intermediate-level maintenance occurred.

In April 1991, Moffett Field was designated for closure as an active military base under the Department of Defense Base Realignment and Closure (BRAC) program. On July 1, 1994, control of the base was transferred to NASA, and the base was renamed Moffett Federal Airfield. NASA operates the Ames Research Center on the northwestern side of Moffett Field. The Navy, however, will continue with environmental restoration activities and remain responsible for remediating Navy contaminant sources.

Wastes have been generated at Moffett Field through maintenance operations, fuel management, and fire training since the early 1930s. Chemicals of potential concern (COPCs) include waste oils and jet fuels; solvents and cleaners; washing compounds; and lesser amounts of gasoline, hydraulic fluids, asbestos, paints, pesticides, battery acid, and polychlorinated biphenyls (PCBs). Wastes were disposed of in unlined landfills, drained through drainage ditches and unpaved areas, and stored temporarily in unlined wastewater ponds. In addition, some underground storage tanks (USTs) and sumps (many of them now removed) were found to have leaked petroleum hydrocarbons and fuels, and lesser amounts of waste oils and solvents.

Environmental studies were initiated at Moffett Field in 1984. The Navy began conducting these environmental restoration activities as part of the Department of Defense Installation Restoration Program (IRP). The Navy conducted an initial assessment study (IAS) in 1984 to gather data on the past use and disposal of hazardous materials at Moffett Field (NEESA 1984). Nineteen sites were identified as potential sources of wastes, including nine sites identified in the IAS and 10 sites added during subsequent investigations (ESA and AR 1986, ERM 1987, ESA and JMM 1986). Five additional sites were identified during field investigations in the early 1990s. The

U.S. Environmental Protection Agency (EPA) proposed placing Moffett Field on the National Priorities List (NPL) in June 1986 and placed it on the NPL in 1987. Placement on the NPL initiated the remedial investigation and feasibility study (RI/FS) process under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Data collected during the initial studies were used to plan the RI/FS. The RI/FS work is coordinated through the August 1990 federal facilities agreement (FFA) with EPA and the California Environmental Protection Agency (Cal EPA) (including the Department of Toxic Substances Control [DTSC] and the Regional Water Quality Control Board [RWQCB], San Francisco Bay Region).

The RI was implemented in two phases. During Phase I, the types and concentrations of chemical contaminants at 19 sites were identified. The Phase I characterization was completed in August 1990. The Phase II investigations were initiated in 1990 to provide more detailed, site-specific data. Phase II investigations revealed a need to organize the RI/FS process into separate OU studies. Six OUs were originally identified at Moffett Field to facilitate the RI/FS process:

- OU1 - IRP soils and groundwater Sites 1 and 2 (landfills)
- OU2 - Near-surface soils at IRP Sites 3, 4, 6, 7, 8, 10, 11, 13, 14, 16, 17, and 18 (OU2 has also been divided into east and west components)
- OU3 - Soils at Sites 12 and 15
- OU4 - Aquifers on the western side of Moffett Field
- OU5 - Aquifers on the eastern side of Moffett Field (not affected by the regional volatile organic compound [VOC] plume)
- OU6 - Wetland areas

In October 1992, however, EPA determined that the aquifers on the western side of Moffett Field were affected by a regional VOC plume emanating from the Middlefield-Ellis-Whisman (MEW) Superfund site south of Moffett Field. EPA determined that these aquifers were subject to the 1989 record of decision (ROD) already written for the MEW site. Consequently, OU4 was deleted and OU5 was modified to include all aquifers not part of the regional VOC plume. OU2 was separated into OU2-West (Sites 8, 16, 17, 18, and the western portion of Site 10, which overlie the regional VOC plume) and OU2-East sites (Sites 3, 4, 6, 7, 11, 13, and the eastern portion of Site 10), which do not overlie the regional VOC plume.

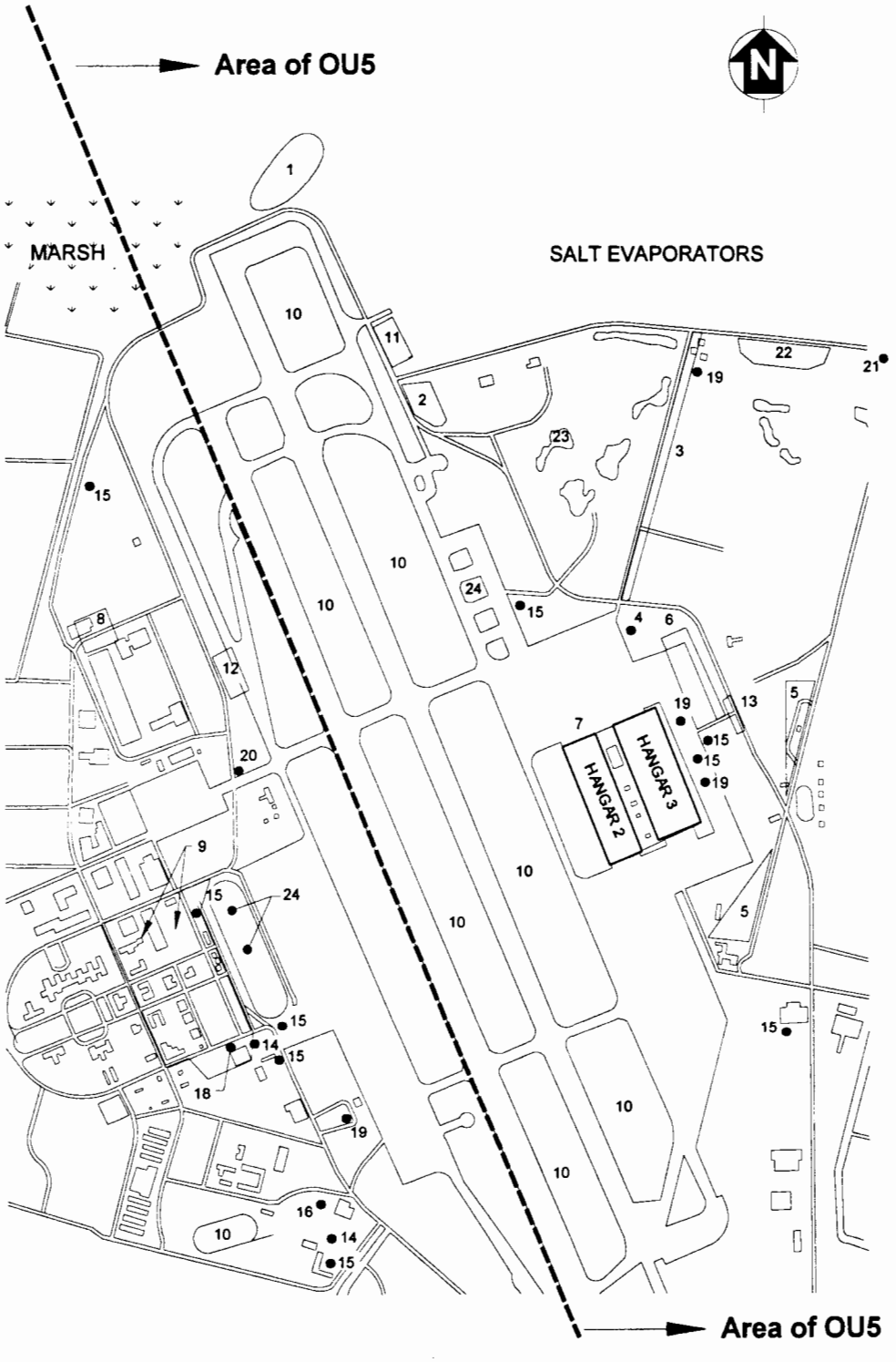
In February 1993, the Navy recommended to the regulatory agencies that all sites containing petroleum and petroleum constituents be removed from the CERCLA process (CERCLA contains an exclusion for petroleum and petroleum constituents). The Navy also recommended that these sites be addressed in a manner consistent with the Resource Conservation and Recovery Act (RCRA) Subtitle I and appropriate state regulations for USTs. The agencies agreed to the modification and corrective actions at petroleum sites are underway. Therefore, OU3 (which contained petroleum-contaminated Sites 12 and 15) was removed, and Sites 5, 9, 14, and 19, which also contain petroleum contamination, have been deferred to the IRP petroleum sites program and will not be addressed through RODs.

The focus of this ROD is OU5 groundwater contamination. The soils investigation activities for OU2 soils overlying OU5 groundwater are provided in the final OU2 RI report published in May 1993 (IT 1993a). Sites with petroleum contamination were also investigated and the results summarized in the Revised Final IRP Petroleum Sites Characterization Report (PRC 1994a). Site-specific information for the sites overlying the OU5 aquifers is also provided in the final OU5 RI and FS reports (IT 1993b; PRC 1995). Figure 3 depicts the location of OU5 at Moffett Field.

1.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

In May 1989, the Navy developed a Moffett Field community relations plan (CRP). The CRP outlined specific activities based on community concerns. The Navy formed a technical review committee (TRC) in 1989 which met quarterly to discuss environmental progress at the site. In addition, in 1993 and 1994 the EPA provided technical assistance grants (TAGs) to the Silicon Valley Toxics Coalition, a local environmental group. The TAG allowed the coalition to hire a consultant to assist in reviewing Moffett Field environmental documents. The Navy formed a restoration advisory board (RAB), which replaced the TRC in October 1994. The RAB is made up of members of the TRC and community and Navy personnel and holds monthly public meetings to discuss environmental progress at Moffett Field. The Navy also prepared several fact sheets for the public on findings of RIs at various sites at Moffett Field.

The OU5 RI report was released in August 1993 (IT 1993b). The OU5 FS report was released in August 1995 (PRC 1995). The proposed plan for remediation of OU5 was released to the public in October 1995. The proposed plan and FS report were made available to the public through both the administrative record and the information repository. The proposed plan was mailed to approximately



SITE TYPE OF WASTE

1 RUNWAY LANDFILL
2 GOLF COURSE LANDFILL
3 MARRIAGE ROAD DITCH
4 FORMER INDUSTRIAL WASTEWATER SURFACE IMPOUNDMENTS
5 FUEL FARM FRENCH DRAINS
6 UNPAVED AREAS SURROUNDING RUNWAY APRON
7 HANGARS 2 AND 3
8 WASTE OIL TRANSFER AREA
9 OLD FUEL FARM
10 CHASE PARK AREA (AND RUNWAY)
11 ENGINE TEST STAND AREA
12 FIREFIGHTING TRAINING AREA
13 EQUIPMENT PARKING AREA
14 ABANDONED TANKS (NOS. 19, 20 67, AND 68) (ALL REMOVED)
15 NINE SUMPS AND OIL/WATER SEPARATORS
16 PW STEAM RACK SUMP NO. 60 (REMOVED)
17 PAINT SHOP SUMP NO. 61
18 DRY CLEANERS SUMP NO. 66
19 LEAKING TANKS NOS. 2. 14, 43 AND 53 (ALL REMOVED)
20 ZOOK ROAD FUEL SPILL
21 PATROL ROAD DITCH
22 GOLF COURSE LANDFILL #2
23 GOLF COURSE LANDFILL #3
24 ACTIVE PETROLEUM SITES

Legend

OU5 Area East of Dashed Line

350' 0 350' 700'

SCALE

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FIGURE 3
MOFFETT FEDERAL AIRFIELD
OU5 RECORD OF DECISION
SITE LOCATION MAP

450 people on Moffett Field's mailing list, on October 27, 1995. The notice of availability for the proposed plan and related documents was published in the *San Jose Mercury News* and *San Francisco Chronicle* on October 26, 1995. A public comment period was held from October 27, 1995 through November 30, 1995. A public meeting was held on November 16, 1995. At this meeting, representatives from the Navy, EPA, and the State of California answered questions about OU5 and supplied the rationale for the selected remedy. A response to the comments received during the public meeting and the public comment period is included in the responsiveness summary, which is part of this ROD. These community participation activities fulfill the requirements of Sections 113(k)(2)(B)(i-v) and 117(a)(2) of CERCLA.

1.4 SCOPE AND ROLE OF RESPONSE ACTION

Twenty-four sites at Moffett Field have been identified and are in some phase of investigation and cleanup process. However, several of these sites have been removed from the Moffett Field CERCLA process, as discussed in Section 1.2. Source control activities for Sites 9, 12, and 14 are currently underway. Sites 16, 17, 18, and the western portion of Site 10 are located on the western portion of Moffett Field and are subject to the conditions of the MEW ROD. Groundwater beneath the western portion of Moffett Field, formerly OU4, also is covered by the MEW ROD. The Navy determined that the OU2-East sites, Sites 3, 4, 6, 7, 11, and 13 and the runway portion of Site 10, do not pose risk to human health and the environment and therefore no action was necessary. The OU2-East ROD documenting this decision was signed in 1994. The remaining sites are planned to be addressed by RODs, and the tentative schedule is as follows:

OU Designation	OU Description	ROD Schedule
OU1	Soil and Groundwater at Landfill Sites 1 and 2	June 1996
OU5	East-side aquifers	June 1996
Station-wide	Station-wide	May 1997

This ROD for OU5 addresses groundwater contamination, specifically the southern plume. The contamination in this area poses the principal threat to human health and the environment because of the risks from drinking groundwater at OU5. The purpose of this response action is to prevent current or future exposure to contaminated groundwater and reduce plume migration.

The installation management strategy is to accelerate actions at the OUs while identifying and closing out assessment activities at sites not requiring action. This strategy allows resources to be concentrated on the OUs requiring action and meets the President's goal of quickly identifying parcels of property that can be transferred to the community or other agencies under the BRAC program.

1.5 SITE CHARACTERISTICS

Since the early 1930s, wastes have been generated at Moffett Field as a result of activities such as maintenance operations, fuel management, and fire training. The types of wastes disposed of included waste oils and jet fuels; solvents and cleaners; washing compounds; hydraulic fluids, asbestos, paints, pesticides, battery acids, and PCBs.

Twenty-four IRP sites have been identified as potential sources of contamination, 14 of which overlie the OU5 groundwater.

Interpretation of the nature and extent of groundwater contamination at the Moffett Field OU5 is based on the Phase I and Phase II data compiled and presented in the OU5 RI report (IT 1993b). Phase I and II OU5 RI groundwater samples were collected from the A, B, and C aquifers. Contaminants identified in the RI as having been detected in the OU5 aquifers include chlorinated hydrocarbons, nonchlorinated VOCs, petroleum hydrocarbons, semivolatile organic compounds (SVOCs), and metals.

Based on the RI data, a preliminary chemical of concern (COC) list was established and was presented in the OU5 human health risk assessment (HHRA) (Tables 1 and 2). The list was later refined based on additional OU5 groundwater data. The modified COC list, consists of trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE), tetrachloroethene (PCE), 1,2-dichloroethane (1,2-DCA), 1,1-DCE, and vinyl chloride. OU5 data collected since 1989 indicate that TCE, 1,2-DCE, PCE, 1,2-DCA, 1,1-DCE, and vinyl chloride were detected at maximum concentrations of 140, 90, 260, 14, 16, and 89 μg/L, respectively. High concentrations of VOCs were detected in samples from well W7-7 near former Tank 43 during 1983 through 1985. Maximum concentrations of PCE; TCE; 1,2-DCE; and vinyl chloride were 110; 7,900; 22,000; and 2,800 μg/L, respectively. All maximum concentrations were detected in a sample collected in November 1983 except 1,2-DCE which was measured in August 1984. However, none of the samples collected from groundwater monitoring wells near well W7-7 (including W7-6, W7-8, W7-9, and W7-10) indicated levels of

TABLE 1

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF CARCINOGENIC COC RISKS

Site	Aquifer	Chemical	Cancer Risk
3	A1	Arsenic	1.1×10^{-4}
3	A1	Bis(2-chloroethyl)ether	2.6×10^{-4}
3	A1	Bis(2-ethylhexyl)phthalate	1.0×10^{-6}
3	A1	Chromium	2.7×10^{-5}
3	A1	1,2-Dichloroethane	1.4×10^{-5}
3	A1	1,1-Dichloroethene	4.1×10^{-5}
3	A2	Chloroform	1.9×10^{-6}
3	C	Chloroform	2.5×10^{-6}
4	A1	Arsenic	1.7×10^{-4}
4	A1	Beryllium	1.3×10^{-4}
4	A1	Bis(2-chloroethyl)ether	2.6×10^{-4}
4	A1	Bis(2-ethylhexyl)phthalate	7.8×10^{-6}
4	A1	Chromium	2.6×10^{-5}
4	A1	1,1-Dichloroethene	1.2×10^{-4}
4	A1	Tetrachloroethene	4.2×10^{-6}
4	A1	Trichloroethene	6.1×10^{-6}
4	A2	Chloroform	1.9×10^{-6}
4	A2	Chromium	3.4×10^{-5}
5 - North	A1	Beryllium	1.3×10^{-4}
5 - North	A1	Bis(2-ethylhexyl)phthalate	1.2×10^{-6}
5 - North	A1	Chromium	2.6×10^{-5}
5 - North	A2	Arsenic	1.1×10^{-4}
5 - North	A2	Bis(2-ethylhexyl)phthalate	5.4×10^{-6}
5 - North	A2	Chloroform	1.9×10^{-6}
5 - South	A1	Bis(2-ethylhexyl)phthalate	1.0×10^{-6}
6	A1	Arsenic	1.1×10^{-4}
6	A1	Tetrachloroethene	3.3×10^{-6}
6	A1	Trichloroethene	1.5×10^{-6}
6	A2	Beryllium	1.3×10^{-4}
6	A2	Chloroform	2.3×10^{-6}
10	A1	Bis(2-ethylhexyl)phthalate	2.0×10^{-6}
10	A1	Beryllium	6.6×10^{-5}
10	C	Arsenic	1.7×10^{-4}
10	C	Beryllium	8.4×10^{-5}

TABLE 1 (Continued)

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF CARCINOGENIC COC RISKS

Site	Aquifer	Chemical	Cancer Risk
7 and 19	A1	Beryllium	1.3×10^{-4}
7 and 19	A1	Bis(2-ethylhexyl)phthalate	1.0×10^{-6}
7 and 19	A1	Carbon tetrachloride	1.2×10^{-5}
7 and 19	A1	Chloroform	2.7×10^{-6}
7 and 19	A1	Chromium	3.1×10^{-5}
7 and 19	A1	1,1-Dichloroethene	5.4×10^{-5}
7 and 19	A1	Tetrachloroethene	3.7×10^{-5}
7 and 19	A1	Trichloroethene	3.1×10^{-6}
7 and 19	A2	Arsenic	1.1×10^{-4}
7 and 19	A2	Beryllium	1.3×10^{-4}
7 and 19	A2	Benzene	4.9×10^{-6}
7 and 19	A2	Bis(2-ethylhexyl)phthalate	1.3×10^{-6}
7 and 19	A2	Chloroform	1.6×10^{-6}
7 and 19	A2	Tetrachloroethene	2.3×10^{-6}

TABLE 2

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF NONCARCINOGENIC COC RISKS

Site	Aquifer Zone	Chemical	Hazard Index
4	A2	Manganese	1.4
4	A2	Thallium	2.0
5 - South	B2	Antimony	2.1
6	A2	Thallium	2.0
10	A1	Antimony	17
10	A1	Thallium	1.5
10	C	Antimony	3.5
7 and 19	A2	Manganese	1.1

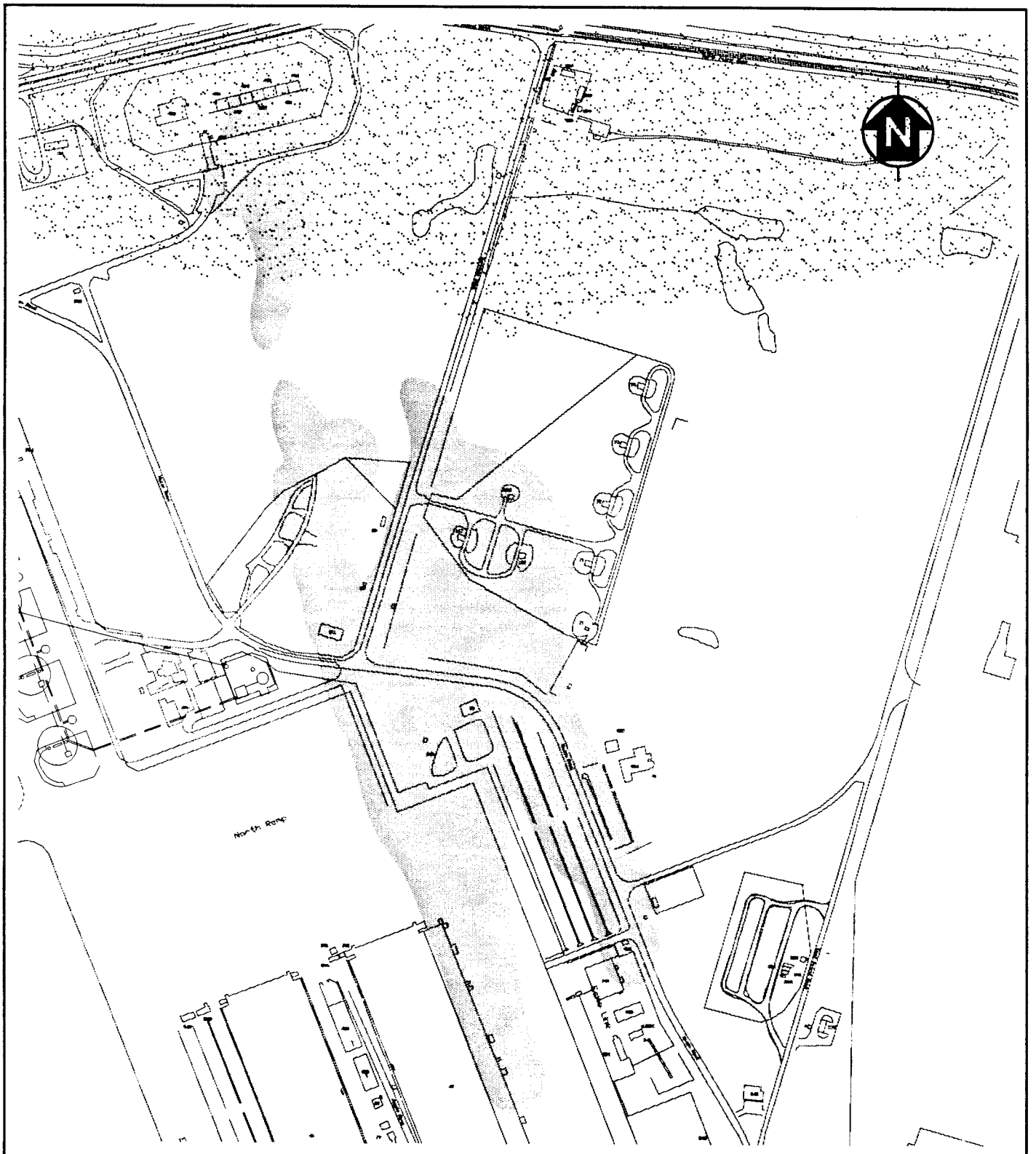
VOCs above 350 μg/L during 1983 through 1985. Furthermore, VOC concentrations declined rapidly in samples collected from well W7-7. Concentrations of TCE; 1,2-DCE; and vinyl chloride were 7.6; 2,574; and 500 μg/L, respectively, in samples collected during November 1985. PCE was not detected at 5 μg/L in the same sample. Cometabolism of VOCs during degradation of fuel-related hydrocarbons may have contributed to the rapid decline in VOC concentrations. The Navy has installed four additional A1-aquifer zone groundwater monitoring wells (W43-1, W43-2, W43-3, and W19-1) in the area of well W7-7 and former Tank 43 since 1985. Samples collected from the nine groundwater monitoring wells near former Tank 43 since 1985 indicate significantly lower VOC concentrations.

The process used to refine the COC list is described in the final OU5 FS report (Sections 2.1 to 2.3). Some inorganic chemicals were identified in OU5 aquifers, but were eliminated from the list of hazardous site-related chemicals because they were detected at ambient concentrations and are naturally occurring.

The primary contaminants in the A1-aquifer zone are chlorinated VOCs, principally TCE and 1,2-DCE. TCE and 1,2-DCE define the extent of contaminant plumes in the A1 aquifer as shown in Figure 4. The chlorinated VOCs are vertically distributed in permeable deposits throughout the A1-aquifer zone to a depth of about 35 feet. Groundwater in the A1-aquifer zone has also been impacted by JP-5 fuel contamination. The Navy is currently addressing petroleum contamination in a separate investigation. The Navy is currently evaluating and cleaning up Moffett Field petroleum sites following RWQCB guidance. An evaluation report documenting RWQCB low-risk criteria is currently planned for petroleum sites. A detailed discussion of petroleum-related contamination is presented in the additional petroleum sites investigation technical memorandum (PRC 1994b).

In the A2-aquifer zone wells at OU5, no detections of chlorinated VOCs above contract required quantitation limits (CRQLs) were observed. Only sporadic and estimated quantities of chlorinated VOCs were measured in A2-aquifer zone samples. Sampling events since 1992 have not confirmed earlier detections. The B2- and the C-aquifer zones are not affected by the COCs.

A complete list of all detected compounds and a comprehensive discussion of the nature and extent of contamination appears in the OU5 RI report (IT 1993b). During the evaluation of the nature and extent of contamination, the quality of data for the sampling and analysis at this site was considered. Additional data may be collected during the remedial design, if necessary.



LEGEND

REGION WITH TOTAL DISSOLVED SOLIDS GREATER THAN 3,000 MG/L

APPROXIMATE EXTENT OF CHLORINATED VOC GROUNDWATER PLUME

FIGURE 4
MOFFETT FEDERAL AIRFIELD
OU5 RECORD OF DECISION
OU5 PLUME

FILE NAME: 044/0238/IRU/SFS/OOU5/PLUME.DWG
DATE: 01/31/96 JLH DN

1.6 SUMMARY OF SITE RISKS

Carcinogenic and noncarcinogenic human health risks were estimated in the HHRA for a hypothetical future residential exposure to chemicals in groundwater which included the ingestion pathway. (Occupational exposures have been evaluated in the final OU5 FS in Appendix C to evaluate if groundwater presents an unacceptable risk to occupational receptors.) Currently, all potential residential exposure pathways associated with groundwater exposure are incomplete. There are no current residential receptors exposed to OU5 groundwater (OU5 groundwater is not used as a drinking water source). Carcinogenic risks in the OU5 HHRA were calculated using California EPA and U.S. EPA carcinogenic slope factors (CSFs).

Groundwater in the upper aquifers within OU5 is not being extracted for use; however, the A aquifer does meet state criteria for a potential drinking water source. Therefore, human health risks in the OU5 HHRA are based on domestic use of upper aquifer groundwater. This conservative assumption was made even though residential development at Moffett Field is not anticipated.

Residential exposure pathways included groundwater ingestion, inhalation of volatilized chemicals, and ingestion of irrigated produce. Table 1 summarizes carcinogenic risks calculated in the OU5 HHRA equal to or greater than 1.0×10^{-6} when risks were summed across exposure pathways. Table 2 summarizes the chemical-specific noncarcinogenic hazard indices at each site that were above EPA's acceptable level of 1.0. Tables 1 and 2 present the potential COCs based only on the RI data. Subsequent data have been collected for OU5. A modified list of COCs (see Table 9 in Section 5.0) was developed by integrating RI data with new data.

Appendix C of the final OU5 FS report presents acceptable COC concentrations for groundwater assuming an occupational exposure scenario. Occupational exposure to groundwater involves different exposure parameters than the residential exposures assessed in the RI report. Occupational exposure is the most likely exposure scenario for the OU5 aquifers and, therefore, an assessment of potential risks to workers was necessary. The assessment found that occupational exposure to groundwater did not present significant risks to workers. The results of the assessment for potential future residential use scenario were used to select COCs and remediation goals.

Ecological Risk Summary

A sitewide ecological assessment (SWEA) is underway at Moffett Field. The SWEA evaluates potential adverse ecological effects caused by on-site contamination from past and current facility operations, and provides information for remedial decision making. The SWEA is divided into two phases. The Phase I SWEA provides a qualitative evaluation of the nature and extent of chemically affected media, the pathways by which ecological receptors may be exposed, the habitat provided by Moffett Field, and the receptors observed or potentially present on or adjacent to the base and identifies potential ecological COCs. Phase II efforts are directed at filling remaining data gaps with information necessary to evaluate the possibility of ecological receptors being adversely affected by contamination from Moffett Field. This evaluation includes examination of the effect of soil gas on burrowing owls. Phase I has been completed at Moffett Field and the results in the draft final Phase I SWEA report (PRC and MW 1994) have been incorporated into discussions in the final OU5 FS report. Evaluations of ecological issues may be modified following completion of the Phase II SWEA. The stationwide FS will incorporate all of the results of the SWEA. However, the Phase I SWEA does not identify chlorinated VOCs associated with potential groundwater exfiltration to surface water targets as an exposure route requiring further investigation during Phase II activities.

Results of the Phase I SWEA may potentially affect the remedial alternatives for treatment of OU5 groundwater. The Phase I SWEA identified several areas where a potentially complete pathway between contaminated groundwater and the ground surface exists. Surface water recharge from OU5 groundwater may occur in Marriage Road ditch and the Navy ditch. A number of floral and faunal species exist in these areas that are potential receptors for the exposed contaminated groundwater. Impacts on ecological habitats were addressed during the development of the remedial alternatives because potentially complete pathways exist between chemical sources in the groundwater and receptors in these habitats.

The Phase I SWEA identified potential wetlands at Moffett Field and classified them according to the U.S. Fish and Wildlife Service (USFWS) classification system (Cowardin and others 1979). A wetland delineation for Corps of Engineers jurisdictional determination was not a part of the Phase I SWEA. Several areas identified as potential wetlands in the Phase I SWEA have since been re-evaluated. Marriage Road ditch conveys stormwater to the Navy ditch which flows to the Building 191 lift station, where it is then pumped to the Northern channel and allowed to flow to San Francisco Bay via Guadalupe Slough. In the Phase I SWEA, Marriage Road ditch and Navy

ditch were both identified as potential wetlands. However, because these ditches are regularly dredged and maintained, they are eligible for the Section 404(f)(1) exemption in the Clean Water Act for "maintenance of drainage ditches." Any remedial action affecting the drainage ditch and channel system would not require a Section 404 permit. However, the substantive requirements of a permit will have to be met.

The stormwater retention ponds were also delineated as potential wetlands. The majority of the site is not vegetated, with a narrow fringe of vegetation along the edges of the ponds. Vegetation in this wetland area is primarily pickleweed and there is a clear topographic break where the ponds begin. Although the fringe area of the stormwater retention ponds could qualify under the technical criteria to be a wetland, or a special aquatic site, wetland considerations are superseded by the National Pollutant Discharge Elimination System (NPDES) general permit dated February 3, 1993 for discharges of stormwater associated with industrial activity in Santa Clara County to South San Francisco Bay or its tributaries. The stormwater retention pond area was constructed as part of the stormwater treatment system under the NPDES regulations (Section 402 of the Clean Water Act), and the pond area is still used for that purpose. Any remedial action affecting the ponds would not require a Section 404 permit.

The Marriage Road ditch and Navy ditch are short-lived surface water systems that receive water from OU5. As discussed earlier, the ditches have been identified as wetlands by using the USFWS classification system. These areas provide habitat for a number of species. The Phase I SWEA identified Marriage Road ditch as damselfly habitat. The Navy ditch has many of the same ecological characteristics as Marriage Road ditch and has been considered potential habitat for a number of species for the purpose of the OU5 ecological summary.

Contaminated groundwater may exfiltrate into OU5 surface water ecosystems; therefore, it is necessary to evaluate the potential risk and how this exfiltration scenario could affect remedial action. The two areas of OU5 that have been evaluated are Marriage Road ditch and Navy ditch. Current and historical data show that these two areas have the only potentially completed surface water pathway exposure routes.

The current ecological receptors in Marriage Road ditch and the Navy ditch are not at risk from any contaminated groundwater exfiltrating from OU5. Ecological toxicity values were compared to existing groundwater chemical concentrations to evaluate the ecological risk posed by OU5

contamination. As a conservative measure, the maximum concentrations for all COCs detected in OU5 groundwater since 1989 were compared to ecological benchmarks as shown in Table 3, with the exception of vinyl chloride. No ecological benchmarks could be found for vinyl chloride. Vinyl chloride has a volatilization half life of 0.805 hours in river systems (EPA 1995a) and is not expected to remain in the ecosystem long enough to have adverse effects. The results of the comparison shown in Table 3 demonstrate that even if the highest levels of COCs detected in the groundwater were to exfiltrate directly into the ditches, there would be no adverse ecological effects that would change the decision making process for remediation.

In comparing OU5 ecological receptors to ecological benchmarks, surrogate species were used because an exact species match was not found as outlined in the Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities produced by the California Department of Toxic Substances Control in August 1994. The surrogate species were chosen based on taxonomic relatedness and known or presumed similarities in physiology and life history.

Only two sediment samples contained an OU5 COC out of eight sediment and nine surface water samples collected throughout Marriage Road ditch and Navy ditch during the summers of 1993 and 1994. The two samples were collected in Marriage Road ditch just upstream of its confluence with the Navy ditch. TCE was detected at estimated values of 3 and 4 micrograms per kilogram (μg/kg) (PRC and MW 1994). All of the ecological benchmarks are significantly above the detection levels for the two samples. In conclusion, there is no ecological risk to the communities in Marriage Road ditch and the Navy ditch from OU5 groundwater contamination.

The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit. Because the selected remedy will likely treat extracted groundwater to nondetectable levels, discharge of treated OU5 groundwater to the local off-site surface waters does not pose an unacceptable ecological risk.

Actual or threatened releases of OU5 COCs, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

TABLE 3

MOFFETT FEDERAL AIRFIELD OU5
ECOLOGICAL RISK SUMMARY

Surrogate Species	Analyte	Endpoint Effect	Benchmark (μg/L)	Maximum[a] Concentration Observed in Groundwater (μg/L)	Benchmark Reference
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	TCE	FW-acute FW-chronic M-acute	45,000 21,900 2,000	140	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Water Boatman (*Corixa punctata*)	TCE	LC50	110,000	140	AQUIRE (EPA 1995c)
Water Flea (*Daphnia magna*)	TCE	LC50	18,000	140	AQUIRE (EPA 1995c)
Flatworm (*Dugesia lugubris*)	TCE	LC50	42,000	140	AQUIRE (EPA 1995c)
Dragonfly (*Ischnura elegans*)	TCE	LC50	49,000	140	AQUIRE (EPA 1995c)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	PCE	FW-acute FW-chronic M-acute M-chronic	5,280 840 10,200 450	260	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Water Flea (*Daphnia magna*)	PCE	EC50	3,200	260	AQUIRE (EPA 1995c)
Flatworm (*Dugesia japonica*)	PCE	LC50	1,400	260	AQUIRE (EPA 1995c)
Water Flea (*Moina macrocopa*)	PCE	LC50	1,800	260	AQUIRE (EPA 1995c)
Opossum Shrimp (*Mysidopsis bahia*)	PCE	LC50	10,200	260	AQUIRE (EPA 1995c)
Midge (*Tanytarsus dissimilis*)	PCE	LC50	30,800	260	AQUIRE (EPA 1995c)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,1-DCE	FW-acute M-acute	11,600 224,000	16	IRIS (EPA 1995b) IRIS (EPA 1995b)
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,2-DCE	FW-acute M-acute	11,600 224,000	90	IRIS (EPA 1995b) IRIS (EPA 1995b)

TABLE 3 (Continued)

MOFFETT FEDERAL AIRFIELD OU5
ECOLOGICAL RISK SUMMARY

Surrogate Species	Analyte	Endpoint Effect	Benchmark (µg/L)	Maximum[a] Concentration Observed in Groundwater (µg/L)	Benchmark Reference
Species not specified (benchmark represents the lowest effect concentration [LEC] observed in the literature search)	1,2-DCA	FW-acute FW-chronic M-acute	1,800 2,000 113,000	14	IRIS (EPA 1995b) IRIS (EPA 1995b) IRIS (EPA 1995b)
Brine Shrimp (*Artemia salina*)	1,2-DCA	EC50	36,400	14	AQUIRE (EPA 1995c)
Water Flea (*Daphnia magna*)	1,2-DCA	EC50	16,000	14	AQUIRE (EPA 1995c)
Scud (*Gammarus fasciatus*)	1,2-DCA	LC50	>100,000	14	AQUIRE (EPA 1995c)
Opossum Shrimp (*Mysidopsis bahia*)	1,2-DCA	LC50	113,000	14	AQUIRE (EPA 1995c)
Leopard Frog (*Rana pipiens*)	1,2-DCA	LC50	4,400	14	AQUIRE (EPA 1995c)
Polychaete (*Ophryothrocha labronica*)	1,2-DCA	LC50	200,000	14	AQUIRE (EPA 1995c)

Notes: [a] These are maximum contaminant concentrations detected since 1989.

FW-acute	Freshwater acute endpoint effect
FW-chronic	Freshwater chronic endpoint effect
M-acute	Marine acute endpoint effect
M-chronic	Marine chronic endpoint effect
LC5O	The statistically estimated concentration that is expected to be lethal to 50 percent of the test organisms.
EC5O	The concentration at which 50 percent of the test organisms show effects other than death.
IRIS	Integrated Risk Information System
AQUIRE	Aquatic Toxicity Information Retrieval Database
TCE	Trichloroethene
PCE	Tetrachloroethene
1,1-DCE	1,1-Dichloroethene
1,2-DCE	1,2-Dichloroethene
1,2-DCA	1,2-Dichloroethane

1.7 EXPLANATION OF SIGNIFICANT CHANGES

The proposed plan for Moffett Field OU5 was released for public comment in October 1995. The proposed plan identified Alternative 5A — collection, air stripping, and discharge — as the preferred alternative. The Navy and EPA reviewed all written and verbal public comments submitted during the public comment period between October 27, 1995 and November 30, 1995. Upon review of these comments, it was determined that no significant changes to the remedy, as it was originally identified in the proposed plan, were necessary.

2.0 DESCRIPTION OF ALTERNATIVES

As part of the FS for OU5, a wide range of remedial alternatives were identified and initially screened based on their technical applicability and implementability for OU5. Under Section 121 of CERCLA, a selected remedial action must be protective of human health and the environment, and it must comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is appropriate. The alternatives were then evaluated based on short-term effectiveness, long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, technical and administrative implementability, and cost effectiveness. Alternatives were then compared against these criteria for selecting the recommended remediation measure. Additionally, state and community acceptance were also considered. Under all the alternatives, a 5-year remedial action review for contaminants remaining on the site is required, as stated in CERCLA Section 104.

The remedial alternatives considered for the southern plume at OU5 are:

- Alternative 1: Groundwater monitoring
- Alternative 2: Institutional controls, indirect restoration
- Alternative 3: Institutional controls, future treatment
- Alternative 4A: Permeable reaction cell
- Alternative 4B: Air sparging and soil vapor extraction (AS/SVE)
- Alternative 5A: Collection, air stripping, and discharge
- Alternative 5B: Collection, ultraviolet (UV) oxidation, and discharge

This section summarizes each of the remedial alternatives for OU5.

Alternative 1: Groundwater Monitoring

This alternative involves a long-term quarterly groundwater monitoring of the OU5 southern plume; no engineering controls are used to treat or contain the migration of contaminated groundwater. This alternative will rely on natural degradation to reduce COC concentrations. Groundwater monitoring does not place any restrictions on groundwater use. Therefore, this alternative is not protective of human health and the environment. The primary ARARs for the southern plume of OU5 are maximum contaminant levels (MCLs) for the COCs. Under Alternative 1, it will take at least 50 years to reach MCLs because this alternative solely depends on natural degradation to reduce COC levels. The anticipated cleanup period is based on groundwater modeling using OU5-specific data. Cleanup times under both active restoration and natural attenuation scenarios are expected to exceed 50 years because of the low groundwater flow rate and high proportion of fine-grained, sorptive sediments at OU5. The estimated present worth cost of Alternative 1 is $2.2 million, assuming a 4 percent annual discount rate and a project life of 50 years.

Alternative 2: Institutional Controls and Indirect Restoration

This alternative includes restricting use of the southern plume, funding a local community environmental project (indirect restoration) such as providing funds for a recycling center or water conservation program, and groundwater monitoring. Under this alternative, institutional controls will be imposed for the southern plume area. No action would be taken to treat or contain the migration of contaminated groundwater. This alternative would rely on natural degradation to reduce COC concentrations. Groundwater will be monitored quarterly until cleanup standards of MCLs for the COCs are met. The primary ARARs for the southern plume are MCLs for the COCs. Due to the slow rate of natural degradation, it will take at least 50 years to reach the cleanup standards of MCLs. The estimated present worth cost is $5.3 million.

Under this alternative, DOD will be obligated to seek Congressional appropriations adequate to ensure continued funding of indirect restoration.

Alternative 3: Institutional Controls and Future Treatment

This alternative includes institutional controls, groundwater monitoring, and the option for a future water treatment plant, should the affected groundwater become necessary for drinking water use. The groundwater will have to be treated if it is to be used as a drinking water supply because concentrations of COCs and ambient concentrations of metals, that are naturally occurring, exceed drinking water standards.

Under this alternative, a water treatment plant will be constructed in the future to reduce COCs to MCLs. The municipalities of the aquifer users will be responsible for the portion of the plant that reduces ambient inorganic constituents. The area of attainment will be considered to be the area with groundwater COC and metal concentrations above MCLs. Natural degradation may reduce the constituent levels to some extent before the future treatment option is implemented. The state, however, does not accept a future treatment plant because it considers the southern plume of OU5 as a potential drinking water source. The state prefers alternatives that can be initiated upon completion of the ROD. Under this alternative, the remedial action objective (RAO) of maintaining current and future beneficial use of groundwater will not be achieved. The estimated present worth cost of this alternative is $5.4 million.

Alternative 4A: Permeable Reaction Cells

This alternative involves the treatment of the southern plume of OU5 groundwater using in situ, passive, permeable reaction cells and hydraulic barriers such as slurry walls to intercept the width of the plume. These cells are trenches excavated perpendicular to the contaminated groundwater flow and filled with a permeable iron and sand material (thus sometimes referred to as an Iron Curtain). As contaminated groundwater flows through the reaction cells, chlorinated hydrocarbons will react with iron fillings and be detoxified. Under this alternative, contaminated groundwater would be restricted from use as a drinking water source until cleanup standards are met. This alternative also includes groundwater monitoring to evaluate the effectiveness of the reaction cells.

The Iron Curtain system is an innovative technology for treating contaminated aquifers. The Navy conducted bench-scale studies in November and December 1994 and January 1995 to evaluate its applicability to OU5 at Moffett Field. The results of the studies indicate that it will be capable of

remediating OU5 groundwater to MCLs. A pilot-scale study is underway at Moffett Field to further evaluate its effectiveness.

There are certain difficulties in implementing this technology. It requires excavation (for trench construction) to a depth of approximately 35 feet in the saturated zones of the A1-aquifer zone. Excavation at this depth may be difficult and will require dewatering.

The primary ARARs are MCLs. Other ARARs include location-specific ARARs that apply to construction activities in wetlands area, and action-specific ARARs applicable to excavated soils and spent reaction cell materials.

The estimated present worth cost of this alternative ranges $27.8 to $32.8 million.

Alternative 4B: Air Sparging and Soil Vapor Extraction

This alternative involves the use of a combination of AS/SVE to treat contaminated groundwater of the southern plume at OU5. In AS, also known as in situ air stripping, air is injected below the water table to volatilize dissolved COCs. SVE wells are then used to collect these vapors. The COCs in the extracted air are then removed using vapor phase treatment systems. This alternative also includes groundwater use restrictions and monitoring.

AS/SVE is an innovative technology and has been proven to be an effective system for removing VOCs from both groundwater and vadose zone soils. The system involves use of air injection and vapor extraction wells. Extracted vapors can be treated using an air pollution control device.

A Phase I pilot-scale test of an AS/SVE system was conducted at Moffett Field Site 9 in January 1995. No testing of this technology was conducted at OU5. A site-specific treatability study will need to be conducted before this technology can be used at OU5. The heterogeneous nature and low permeability soils at OU5 make it less desirable.

The primary ARARs for the OU5 southern plume are MCLs. Other ARARs include air emission regulations, specifically the Bay Area Air Quality Management District (BAAQMD) regulations that require control of VOCs from SVE operations and construction of air injection wells that require compliance with Santa Clara Valley Water District (SCVWD) regulations; action-specific ARARs

related to wastes generated through construction activities such as contaminated soil cuttings from well installations; and location-specific ARARs that apply to construction activities in wetland areas.

The estimated present worth cost of this alternative ranges from $32.3 to $48.9 million.

Alternative 5A: Collection, Air Stripping, and Discharge

This alternative involves extracting groundwater from the OU5 southern plume, treating the extracted groundwater aboveground using an air stripping system, and discharge of treated water. Air stripping removes contaminants from extracted groundwater by bringing contaminated groundwater into contact with an air stream above ground. Volatile contaminants will volatilize from the water and enter the air stream. The discharge method requires site-specific studies to evaluate technical feasibility. Some of the discharge options evaluated include discharge into sanitary or storm sewer, reinjection into the aquifer, and water reuse. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course or other potential uses at the facility. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit. Groundwater restrictions and monitoring of the southern plume are also part of this alternative. Restrictions on the domestic use of the groundwater at OU5 will be noted in the Master Plan for the government's land uses until the cleanup standards are met. The continued operation and maintenance of the Building 191 pump station and associated drainage system is also a part of this alternative.

The air stripping system is a proven technology in removing VOCs from contaminated groundwater. The system will treat groundwater extracted from the southern plume of OU5 at a flow rate of approximately 80 gallons per minute (gpm) for at least 50 years. Air stripping systems are readily available and are easily implementable.

The primary ARARs for the southern plume are MCLs for the COCs. Other ARARs include air emission regulations, specifically the BAAQMD regulations that require control of VOCs from the air stripping system; ARARs dealing with construction of extraction wells; and action-specific ARARs related to wastes generated through construction activities such as excavated soils, drill cuttings, and filter solids. ARARs applicable to the various discharge options include California nondegradation policy (Resolution 68-16), underground injection control standards (40 CFR 144-147), and NPDES regulations.

The estimated present worth cost of this alternative ranges from $13.9 to $17.1 million. Alternative 5A is the most cost-effective alternative among the active treatment technologies proposed.

Alternative 5B: Collection, Ultraviolet (UV) Oxidation, and Discharge

This alternative involves extracting groundwater from the OU5 southern plume, treating extracted groundwater above ground using a UV oxidation treatment system, and discharging of treated water. Groundwater restrictions and monitoring are also part of this alternative. The UV oxidation system requires testing using site-specific water to evaluate effectiveness. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course or other potential uses at the facility. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit. Groundwater restrictions and monitoring are also part of this alternative.

UV oxidation systems can be effective in removing VOCs from contaminated aquifers with low turbidity. However, due to high turbidity levels, groundwater at OU5 will require pretreatment to reduce its turbidity. In addition, a treatability study would be required to determine the system's by-products and concentrations generated during treatment of OU5 southern plume groundwater at Moffett Field.

All the ARARs described for Alternative 5A also applies to this alternative.

The estimated present worth cost of this alternative is $17.9 million.

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedial alternative complies with ARARs. Section 121 (d) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), states that remedial actions must attain or exceed ARARs. ARARs may include regulations, standards, criteria, or limitations promulgated under federal or state laws. An ARAR may be either "applicable," or "relevant and appropriate," but not both. The NCP (40 Code of Federal Regulations [CFR] Part 300) defines "applicable," and "relevant and appropriate" as follows:

- "Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."

- "Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate."

The preliminary identification of ARARs involves considering a number of site-specific factors including potnetial remedial actions, compounds at the site, physical characteristics of the site, and site location. A requirement is applicable if it specifically addresses or regulates the hazardous substance, pollutant, contaminant, action being taken, or other circumstances at the site. To determine whether a particular requirement would be legally applicable, it is necessary to evaluate specific jurisdictional prerequisites of the statute or regulation. All pertinent jurisdictional prerequisites must be met for the requirement to be applicable. Jurisdictional prerequisites include:

- Who, as specified by the regulation, is subject to its authority
- The types of substances and activities listed as falling under the authority of the regulation
- The time periord for which the regulation is in effect
- The types of activities the regulation requires, limits, or prohibits

If jurisdictional requirements are met, the requirement is applicable. If not, the next step is to consider whether the requirement is relevant and appropriate (EPA 1988).

The basic considerations when determining whether a requirement is relevant and appropriate include evaluating whether the requirement (1) regulates or addresses problems sufficiently similar to those encountered at the CERCLA site (that is, relevance) and (2) is appropriate to the circumstances of the release, such that its use is well suited to the particular site. Determining whether a requirement is relevant and appropriate is site specific and must be based on best professional judgment (EPA 1988).

A requirement may be relevant but not appropriate for the specific site. Only those requirements that are determined to be both relevant and appropriate must be complied with. Portions of a requirement may be relevant and appropriate even if a requirement in its entirety is not (EPA 1988).

ARARs identified for remedial actions are based on anticipated chemicals present, the location of the site, and possible remedial actions for the site. The following sections discuss how the final alternative complies with chemical-specific, location-specific, and action-specific ARARs.

3.1 CHEMICAL-SPECIFIC ARARs

Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. If a chemical has more than one cleanup level, the most stringent level will be identified as an ARAR for this remedial action.

Chemical-specific water quality standards are promulgated under a variety of federal and state statutes. Table 4 summarizes the chemical-specific ARARs for OU5. Those requirements that are OU5 ARARs are summarized below.

The primary state legislation which governs California water quality is the Porter-Cologne Water Quality Control Act (Porter-Cologne). This act authorizes the SWRCB and the RWQCB to develop and implement regulations, plans, and policies to protect the waters of the state. As such, the SWRCB established Resolution 88-63 which provides the criteria for a potential drinking water source. Potential groundwater drinking water sources are defined as aquifers that contain groundwater with less than 3,000 milligrams per liter (mg/L) total dissolved solids (TDS) and have a pumping yield of at least 200 gallons per day (gpd) (SWRCB 1988). The OU5 southern plume area groundwater meets these criteria. Therefore, the defined beneficial use of the southern plume area groundwater as a potential drinking water source dictates the selection of chemical-specific ARARs for the OU5 southern plume area.

MCLs have been identified as relevant and appropriate requirements for the OU5 southern plume area.

TABLE 4

MOFFETT FEDERAL AIRFIELD OU5
GROUNDWATER CHEMICAL-SPECIFIC ARARs

Citation	Description	ARAR Determination	Comments
Safe Drinking Water Act - 42 USC § 300			
40 CFR Part 141	National Primary Drinking Water Standards: establishes health-based standards for public water systems and specifies Maximum Contaminant Levels (MCLs)	Relevant and appropriate for the southern plume area	MCLs are applicable to water supplies. The uppermost aquifer is not a water supply; therefore, this requirement is not applicable. The NCP stipulates that where MCLGs are not relevant and appropriate, the MCL may be relevant and appropriate under the circumstances of the release. MCLs are relevant and appropriate for potential drinking water aquifers. Even though OU5 is not a current drinking water source; and the beneficial use evaluation for OU5 indicates that the reasonable probable future beneficial uses are not drinking water, the OU5 southern plume area does meet the definition of a potential drinking water source as defined in State Water Resources Control Board (SWRCB) Resolution 88-63. Therefore, MCLs are relevant and appropriate for the southern plume area. MCLs have been promulgated for the chemicals of concern (COCs) and are listed in Table 9.
Porter-Cologne Water Quality Control Act - California Water Code §§ 13000 et seq.			
Water Quality Control Plan for the San Francisco Bay Basin, Region 2	Incorporates statewide water quality control plans and policies; establishes water quality objectives and implementation plans to meet water quality objectives and protect beneficial uses; and provides procedures for selecting cleanup goals	Applicable	The basin plans apply to all waters of the state. They incorporate other state policies and regulations to provide a comprehensive plan for maintaining water quality within the basin. The procedures for selecting cleanup goals meet the definition for chemical-specific ARARs in that they define a process for determining acceptable concentrations that can be found in the ambient environment. These procedures are applicable to OU5.

TABLE 4 (Continued)

MOFFETT FEDERAL AIRFIELD OU5
GROUNDWATER CHEMICAL-SPECIFIC ARARs

Citation	Description	ARAR Determination	Comments
Resolution 68-16	California nondegradation policy: resolves that existing high quality water will be maintained; any activity that produces or may produce a waste or increased concentration of waste and that discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements. In general, this policy is implemented by establishing water quality objectives for surface waters and groundwaters consistent with the goals stated in the policy	See Table 6	This resolution was established to ensure that discharges to waters of the state do not cause degradation of those waters. The Navy does not believe this resolution is a chemical-specific ARAR for insitu groundwater (that is, a standard to be used to set cleanup goals for contaminated aquifers). It will be evaluated as an action-specific ARAR in conjunction with any discharges that may occur as part of the remedial actions. RWQCB believes that the resolution is a chemical-specific ARAR. The OU5 feasibility study demonstrates that it is not technically or economically feasible to treat the contaminated groundwater to non detect levels. Cleaning up the southern plume area to MCLs and monitoring the groundwater in the northern plume area will maintain current and potential beneficial uses. Therefore, the alternate cleanup goals meet the resolution's requirements.
Resolution 92-49	Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304: specifies criteria for the oversight of investigations and remedial activities resulting from discharges or potential discharges of waste to the waters of the state	Relevant and appropriate	The policy includes language with regard to establishing cleanup goals, specifically Section G. The procedures in Section G are relevant and appropriate to OU5.

3.2 LOCATION-SPECIFIC ARARs

Location-specific ARARs are restrictions on the concentrations of hazardous substances or on the conduct of activities solely because they are in specific locations. Special locations include flood plains, wetlands, historic places, and sensitive ecosystems or habitats. There are several special locations at Moffett Field, including the wetlands area at the northern end of the base, which provide habitat to several endangered or protected species (NEESA 1984; PRC and MW 1994). Table 5 summarizes location-specific ARARs for OU5.

The selected remedial action can be implemented to comply with all location-specific ARARs. Construction activities will not be initiated in any wetlands. All design and implementation plans will be reviewed by regulatory personnel.

3.3 ACTION-SPECIFIC ARARS

Action-specific ARARs are technology- or activity-based requirements or limitations for remedial activities. These requirements are triggered by the particular remedial activities conducted at the site and indicate how a selected remedial alternative should be achieved. The selected remedial action requires the collection of groundwater. The construction of collection wells will comply with SCVWD well construction regulations (SCVWD 1989). Table 6 summarizes action-specific ARARs for OU5.

The air stripper generates an air stream that must meet the BAAQMD substantive requirements prior to discharge. The emission stream from the air stripper will comply with BAAQMD regulations. All action-specific ARARs applicable to the selected discharge method of the treated groundwater will be complied with.

Construction activities and activities in the ongoing operation of the treatment system may generate waste materials, such as excavated soils, drill cuttings, and filter solids. The manner in which these materials will be handled depends on the nature of the materials. Materials will be characterized (for example, as solid or hazardous wastes) in accordance with the CCR Title 22, Division 4.5, Chapter 11.

TABLE 5

MOFFETT FEDERAL AIRFIELD OU5
LOCATION-SPECIFIC ARARs

Location	Requirement	Citation	Comments
Wetland	Action to minimize the degradation of wetlands. Action to prohibit discharge of dredged or fill material into wetland without a permit	40 CFR 6, Appendix A; CWA §§ 402 and 404; and 40 CFR 230 and 231	Northern areas of Moffett Field are considered wetlands. An outfall for the station storm drainage system is in this area. Therefore, this requirement is applicable for discharges of treated groundwater to local off-site surface waters in the event that water reuse and discharge to a POTW become infeasible.
Within coastal zone	Conduct activities consistent with approved state management programs	Coastal Zone Management Act (16 USC §§ 1451 et seq.) California Coastal Act of 1976 (14 CCR §§ 13001 13600)	OU5 is in a coastal zone. This requirement is applicable for discharges of treated groundwater to local off-site surface waters in the event that water reuse and discharge to a POTW become infeasible.
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts	National Archaeological and Historical Preservation Act (16 USC Section 46); 36 CFR Part 65	A preliminary inventory of properties identified three buildings on the eastern side of Moffett Field that potentially satisfy the requirements of Category I historic preservation (Buildings 46, 47, and 55). These requirements are applicable to any activity that may impact these properties or sites. The Navy will consult with the state historic preservation specialists prior to finalizing any RAs for OU5.

TABLE 6

MOFFETT FEDERAL AIRFIELD OU5
ACTION-SPECIFIC ARARs

Potential Action	Requirement Descriptions	Citation	Comments
Surface Water Discharge	1) National Pollutant Discharge Elimination System (NPDES) regulations which stipulate requirements for permits, best available technology (BAT), best conventional control technology (BCT), and effluent limitations	40 CFR 122.44(a), 122.44(e), and 122.41(i)	BAT, other effluent limitations, and discharge monitoring requirements are applicable to discharges of treated groundwater to surface water that occur as part of RA. Treated groundwater will be discharged to surface waters if water reuse and discharge to a POTW become infeasible.
	2) Plans that establish water quality standards (including beneficial use designations, water quality objectives to protect uses, and implementation programs) that apply to specific water basins	Water Quality Control Plan, San Francisco Bay Region 2	The point source control measures in the implementation plan given in the basin plan are applicable to all RAs that include a discharge of treated groundwater to surface water.
	3) California nondegradation policy resolves that discharges to high quality water must be treated using best practicable treatment or control necessary to meet waste discharge requirements and protect beneficial uses	Resolution 68-16	Applicable to all RAs that include discharges of treated groundwater to surface water.
	4) Policy and procedures for the oversight of investigations and cleanup and abatement of discharges of waste that affect or threaten water quality. It requires actions for cleanup abatement to conform to Resolution 68-16, water quality control plans and policies, and applicable provisions of 23 CCR, Division 3, Chapter 15 as feasible	Resolution 92-49	The policy includes language with regard to establishing cleanup goal, specifically Section G. The procedures in Section G are relevant and appropriate to OU5.
	5) Priorities for the disposal of water extracted from groundwater cleanup sites.	San Francisco Bay Regional Water Quality Control Board Resolution 88-160	The procedures for the evaluation of discharge of treated groundwater contained in this resolution are relevant and appropriate for OU5.
Discharges to Groundwater	1) Plan establishes water quality standards (including beneficial use designations, water quality objectives to protect uses, and implementation programs) that apply to specific water basins	Water Quality Control Plan, San Francisco Bay Region 2	Applicable for all RAs that include discharges to groundwater occur.

TABLE 6 (Continued)

MOFFETT FEDERAL AIRFIELD OU5
ACTION-SPECIFIC ARARs

Potential Action	Requirement Descriptions	Citation	Comments
Discharges to Groundwater (continued)	2) California nondegradation policy resolves that discharges to high quality water must be treated using best practicable treatment or control necessary to meet waste discharge requirements and protect beneficial uses	Resolution 68-16	Applicable for OU5 if discharges to groundwater occur as part of RA activities.
	3) Policy and procedures for the oversight of investigations and cleanup and abatement of discharges of waste that affect or threaten water quality. It requires actions for cleanup abatement to conform to Resolution 68-16, water quality control plans and policies, and applicable provisions of 23 CCR, Division 3, Chapter 15 as feasible	Resolution 92-49	The policy includes language with regard to establishing cleanup goal, specifically Section G. The procedures in Section G are relevant and appropriate to OU5.
Air Emissions	Rules and regulations pertain to stationary sources of air emissions. Rules address visible emissions prohibition, incinerator standard, nuisance, and compliance with ambient air emission standards and other standards	San Francisco Bay Area Air Quality Management District Regulation 8-47.	This rule is applicable to discharges of organic compounds from air strippers.
Storage or Treatment With Tanks	Standards for tank systems establish design and operational requirements for the storage and/or treatment in tanks at hazardous waste treatment, storage, and disposal facilities	22 CCR, Chapter 30, Articles 24, 25	Relevant and appropriate because tanks are used for storage or treatment of contaminated groundwater as part of OU5 RA.

Drill cuttings and excavated soils generated during site activities may exceed toxicity characteristic hazardous waste regulatory levels for chlorinated VOCs. If so, they will be managed as hazardous wastes and shipped to an appropriate disposal site.

A precise assessment of whether the solids from the bag filter system preceding the air stripper are hazardous or nonhazardous cannot be made at this time. However, due to the very low concentrations of COCs in the groundwater, it is very likely that the filtration solids will be disposed of as a solid waste. If the filtration process residuals exceed the regulatory levels, these materials will then be hazardous wastes and will be handled accordingly.

Before sending any hazardous waste to a disposal facility, the waste will meet the corresponding treatment standard promulgated in CCR Title 22, Division 4.5, Chapter 18. Any on-site management activities of a hazardous waste or material that contains a hazardous waste would meet the appropriate substantive requirements of CCR Title 22, Division 4.5, Chapter 14 and the corrective action management unit (CAMU) rule in CCR Title 22, Section 66264.552.

4.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents a comparative analysis of alternatives based on site-specific needs and evaluated according to the nine CERCLA criteria. A summary of each alternative is provided in Table 7 for reference during the comparative analysis narrative.

Overall protection of human health and the environment and compliance with ARARs unless waived are the two threshold criteria. For any alternative to be eligible for selection, it must meet these two criteria. The following five criteria are balancing criteria used to analyze the trade-offs among alternatives. These five criteria include:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume
- Short-term effectiveness
- Implementability
- Cost

TABLE 7

MOFFETT FEDERAL AIRFIELD OU5
SUMMARY OF ALTERNATIVES

Alternative Number	Collection	Treatment	Discharge	Other Action
1	No action	No action	No action	Groundwater monitoring
2	No action	No action	No action	Institutional control; groundwater monitoring; indirect restoration
3	No action	Future treatment plant	No action	Institutional control; groundwater monitoring
4A	No action	Iron Curtain	No action	Institutional control; groundwater monitoring
4B	No action	Air sparging/soil vapor extraction with air pollution control device	No action	Institutional control; groundwater monitoring
5A	Groundwater will be extracted at a rate of 80 gpm for 50 years	Air stripper with filtration pretreatment	Reuse, discharge to POTW or storm drain	Institutional control; groundwater monitoring
5B	Groundwater will be extracted at a rate of 80 gpm for 50 years	UV/oxidation with filtration pretreatment	Reuse, discharge to POTW or storm drain	Institutional control; groundwater monitoring

Notes:

gpm Gallons per minute
POTW Publicly owned treatment works
UV Ultraviolet

The following two criteria are called modifying criteria under the NCP:

- State acceptance
- Community acceptance

Overall Protection of Human Health and the Environment

All alternatives currently meet the threshold criterion of overall protectiveness of human health because the aquifer is not currently being used. The northern plume area is already protective of human health and the environment, even under future exposure scenarios. However, in the future, Alternative 1 may not meet this threshold criterion for the southern plume area because there would be no restrictions to prevent the use of the contaminated aquifer in the southern plume area as a drinking water source. All of the other alternatives include institutional controls until the MCLs for the COCs are attained in the southern plume area; therefore, all alternatives will be protective during the period the restrictions are in place.

The conditions at OU5 are already protective of the environment. No unacceptable risks to environmental receptors have been identified based on available data and groundwater modeling. The Phase I SWEA does not identify chlorinated VOCs as COCs in the ecological assessment areas (PRC and MW 1994).

Alternatives 1, 2, and 3 do not involve any immediate actions that would reduce the migration of the plume, and rely on natural degradation processes to reduce COC concentrations. Alternatives 4A, 4B, 5A, and 5B involve immediate actions to reduce the COC concentrations in the aquifer, and thus, reduce migration of the COC plume.

Applicable or Relevant and Appropriate Requirements

All alternatives except Alternative 1 meet the threshold criterion of compliance with ARARs.

The following discussion compares the alternatives based on the remaining seven criteria.

Long-term Effectiveness and Permanence

The northern plume area does not present an unacceptable risk to human or environmental receptors. The contaminated aquifer in the southern plume area contains naturally occurring inorganic constituents that have ambient concentrations that exceed MCLs. Therefore, even when the COCs are reduced to cleanup levels, the residual risk associated with ingesting inorganic constituents at ambient concentrations may be unacceptable. Because of this, Alternative 3 provides good potential for long-term effectiveness for the southern plume area. This alternative would involve building a treatment plant for COCs when the aquifer is actually needed for drinking water. The COC treatment will be integrated with inorganic treatment. After COC MCLs are attained, the inorganic treatment plant will continue to operate and protect residents from residual risk.

Alternative 4A provides good long-term protection for the southern plume area. This alternative is a passive treatment system and, as such, has minimal operation and maintenance (O&M) and equipment replacement requirements. Any alternative that includes mechanical equipment, electrical devices, or process equipment (Alternatives 3, 4B, 5A, and 5B) will require ongoing maintenance for effective performance. Since desorption and advective flow are the restoration-rate determining parameters for OU5, all alternatives (Alternatives 4A, 4B, 5A, and 5B) will achieve cleanup standards within the same relative time frame. The ability for any technology to reach cleanup standards significantly faster than natural processes can only be accurately assessed through long-term system evaluation.

Reduction of Toxicity, Mobility, and Volume

Alternatives 1 and 2 provide reduction of toxicity and volume of OU5 contaminants only through natural degradation. Alternative 3 also relies on natural degradation to reduce the toxicity and volume until the aquifer is actually required for a drinking water source. At that time, the supply well will reduce volume by extracting contaminated groundwater and treating it. Alternatives 4A, 4B, 5A, and 5B all reduce toxicity, mobility, and volume by treating groundwater immediately and in a relatively shorter time frame.

Short-Term Effectiveness

None of the alternatives would have any adverse short-term impacts. However, Alternatives 1 and 2 are the most effective in the short term because there is less potential for exposure to contaminated

media with alternatives that do not include construction activities. For other alternatives with construction, workers may be exposed to contaminated soils and groundwater during the construction of the treatment system and its components. However, this exposure can be minimized by following a health and safety plan (HSP) and Occupational Safety and Health Administration (OSHA) regulations.

None of the alternatives can affect background (naturally occurring) inorganic concentrations; therefore, they cannot attain the RAO of maintaining the future beneficial use of a drinking water supply. Water extracted from the A1-aquifer zone will require inorganic treatment prior to distribution.

Implementability

All alternatives can be implemented. Alternatives 4A, 4B, and 5B present the greatest implementation challenges due to the invasive nature of the construction requirements and the innovative nature of the treatment technologies involved. Air stripping has wide application and is the most implementable.

Cost

Table 8 summarizes the estimated present worth cost for each alternative. Alternative 2 is the least costly of the alternatives that meet RAOs associated with preventing unacceptable exposure to COCs and maintaining current beneficial uses. Alternative 3 is the least costly of the alternatives that involve treatment. Alternative 5A is the most cost-effective of the alternatives that involve immediate treatment over the projected lives of the alternatives.

State Acceptance

The State of California and EPA concur with the Navy's preferred alternative.

Community Acceptance

The responsiveness summary, attached to this ROD, addresses the community concerns on the Navy's selected remedy.

TABLE 8

MOFFETT FEDERAL AIRFIELD OU5
COST COMPARISON

Alternative	Capital and Construction Cost ($)	O&M Cost ($)	Present Worth Cost ($)[a]
1	9,400	2,180,400	**2.2**
2	9,400	2,824,900	**5.3**[b]
3	37,700	5,359,600	**5.4**
4A	4,416,300 - 5,721,300	23,380,900 - 27,133,500	**27.8 - 32.8**
4B	3,885,100 - 6,393,900	28,483,200 - 42,517,500	**32.3 - 48.9**
5A	1,342,100 - 1,522,100	12,625,100 - 15,630,400	**13.9 - 17.1**
5B	1,727,200	16,148,100	**17.9**

Notes:

Present worth costs are given in millions of dollars.

[a] Present worth costs are based on a 4 percent discount rate over a 50-year project life.
[b] Includes $2.5 million for indirect restoration

5.0 THE SELECTED REMEDY

Based upon considerations of the requirements of CERCLA, the detailed analysis of alternatives, and public comments, the Navy, Cal EPA, and EPA have determined that Alternative 5A — collection, air stripping, and discharge — is the most appropriate remedy for the southern plume at OU5 and that no action is required (expect for groundwater monitoring) for the northern plume at OU5. The selected remedy will include groundwater extraction and monitoring for an estimated period of 50 years, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation.

The groundwater cleanup standards for the OU5 southern plume are MCLs for each COC. However, due to the lithology of Moffett Field (primarily silt and clay), achieving the cleanup standards may not be technically feasible. If it becomes evident that achieving cleanup standards is technically not feasible, the selected remedy may be re-evaluated. Following construction and startup of the treatment system, the Navy will monitor the performance of the system to assess system effectiveness. Details of the evaluation criteria will be presented in the remedial design. MCLs were selected as the cleanup standards for the southern plume area since the A1-aquifer zone in the southern plume area is a potential drinking water source as defined by SWRCB Resolution 88-63. MCLs have been established for all of the COCs and are presented in Table 9.

The extracted groundwater from the southern plume, at approximately 80 gpm, will be treated using a conventional air stripping system. Air emissions from the air stripper are anticipated to meet BAAQMD standards without any controls because the levels of the COCs in groundwater are low. A final determination of control requirements will be made during the preliminary stage of the remedial design. If the risk levels exceed 1.0×10^{-6} excess cancer risk, then control equipment may be installed. The type of control equipment will also be determined during the preliminary stage of the remedial design.

The treated groundwater will be discharged appropriately. Several discharge options including reinjection, discharge to the storm and sanitary sewers, or reuse were considered. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit. The evaluation for the specific discharge option will conform to the procedures outlined in RWQCB Resolution 88-160.

TABLE 9

MOFFETT FEDERAL AIRFIELD OU5
MODIFIED COC LIST

Chemical	Maximum Concentration Level[1] (µg/L)	Water Quality Criteria for Protection of Aquatic Life (µg/L)	
1,2-Dichloroethane	0.5	FW-acute	1,800
1,2-Dichloroethene	6	FW-acute	11,600
1,1-Dichloroethene	6	FW-acute	11,600
Tetrachloroethene	5	M-chronic	450
Trichloroethene	5	M-acute	2,000
Vinyl chloride	0.5	NA	

Notes:

[1] The more stringent of the federal and State of California maximum contaminant level is given. Concentrations are in micrograms per liter (µg/L).

FW-acute Freshwater acute endpoint effect (EPA 1995b)

M-chronic Marine chronic endpoint effect (EPA 1995b)

M-acute Marine acute endpoint effect (EPA 1995b)

NA Not applicable

The continued operation of Building 191, the pump station, is necessary for successful implementation of the OU5 cleanup (and for continued runway operation) and is therefore considered part of the selected OU5 pump and treat remedy. Without its operation, flooding of the northern end of the runways and surrounding areas, including portions of the golf course, which overlie the OU5 east side aquifers, will occur during the rainy season. Therefore, the Building 191 pump station is a component of the groundwater remedy and must remain operational. The necessity of continued operation and maintenance of the pump station will be noted in the Master Plan for the government's land uses.

In the event of future conveyance or change in land use, subsequent landowners may propose remedy modifications to the Navy. If appropriate, the remedy may be changed pursuant to CERCLA Section 120 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Section 300.430(f)(4)(iii). Access restrictions on the domestic use of the OU5 groundwater will also be placed in the Master Plan.

If groundwater concentrations in the northern plume exceed water quality criteria for protection of aquatic life (see Table 9), potential risks to ecological receptors could occur. In this situation, the Navy will address the elevated concentrations consistent with the emergency response procedures outlined in CERCLA and the NCP.

6.0 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, as required by Section 121 of CERCLA, through restricting access to the southern plume area groundwater, containing migration of the plume through groundwater extraction, removing COCs from the extracted water, and discharging. Access restrictions on domestic use of the groundwater at OU5 will be noted in the Master Plan for the governments' land uses until the cleanup standards are met. Removal of the COCs from groundwater and aquifer material minimizes the potential for exposure and release to the environment. However, even after MCLs are attained for the COCs, the groundwater will need to be treated to remove naturally occurring inorganic constituents before it is used for drinking.

There are no unacceptable short-term risks that will be caused by implementation of the selected remedy. All by-products of groundwater will be handled to protect human health and the environment. Noise associated with air stripper blowers would not have a significant impact on the surrounding communities.

The nearest residential area is approximately 1 mile southwest of OU5. Worker exposure during remedial construction and groundwater monitoring will be minimized by following proper health and safety procedures. Based on available data, the northern plume area poses no risk to human health and the environment.

The selected remedy will comply with all the requirements of all ARARs including federal and state MCLs for the COCs identified. No ARAR waivers are identified at this time.

One of the primary reasons the proposed treatment was selected was because of cost effectiveness. Air stripping was the most cost-effective alternative among the active treatment technologies proposed.

The selected remedy will permanently and significantly reduce the toxicity, mobility, and volume of contaminants at OU5 in a shorter period of time than the passive alternatives. Collection by groundwater extraction will reduce the volume of contamination within the permeable zones. Collection will also reduce downgradient contaminant migration. Depending on the desorption rate of COCs from the low permeability zones, COC levels can be significantly reduced after removal and treatment of groundwater at OU5. If the treated groundwater is to be used for drinking purposes, the treatment system will have to include a treatment system that permanently removes inorganic constituents from groundwater.

The selected remedy will meet the statutory requirement to use permanent solutions and treatment technologies to the maximum extent practicable.

The selected remedy satisfies the preference for treatment because it involves the removal and treatment of contaminated groundwater. A remedy involving no treatment is the least desirable option because of the designation of OU5 groundwater in the southern plume as a potential drinking water source.

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ATTACHMENT 1

RESPONSIVENESS SUMMARY FOR OPERABLE UNIT 5
MOFFETT FEDERAL AIRFIELD, CALIFORNIA
(FORMERLY NAVAL AIR STATION MOFFETT FIELD)

CONTENTS

CONTENTS (Continued)

1.0 OVERVIEW

This responsiveness summary was prepared for operable unit 5 (OU5) at Moffett Federal Airfield (Moffett Field), California. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that a responsiveness summary that details the community's concerns on the Navy's selected remedy be prepared following the public comment period and public meeting. This document is prepared to fulfill that requirement.

OU5 consists of contaminated aquifers on the eastern side of Moffett Field that are not affected by a regional volatile organic compound (VOC) plume emanating from the Middlefield-Ellis-Whitman (MEW) Superfund site, south of Moffett Field. The chemicals of concern (COCs) in OU5 groundwater are 1,2-dichloroethene (1,2-DCE), 1,2-dichloroethane (1,2-DCA), 1,1-DCE, tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride. The contaminated aquifer zone that requires treatment is the area designated as the southern plume area in the A1-aquifer zone. The northern plume area is not a potential source of drinking water, does not pose unacceptable risk to human health and the environment and therefore, it does not require treatment. Groundwater monitoring of the northern plume is also a portion of the selected remedy.

The selected remedy proposed by the Navy includes extraction, treatment using air stripping system, and discharge of treated water. The remedy also includes institutional controls and groundwater monitoring. The cleanup goals are the maximum contaminant level (MCLs) for each of the COCs. Table 9 shows the list of COCs and cleanup goals. The restoration time is estimated to be at least 50 years.

The groundwater extraction methods will be determined during the remedial design.

The method of discharge of treated groundwater described in the final feasibility study (FS) is reinjection. However, due to the complexity and uncertainties surrounding reinjection, the discharge method was not specified in the proposed plan. The Navy's selected discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under a National Pollutant Discharge Elimination System (NPDES) permit.

The community in general supports the Navy's select remedy, although there are concerns. These concerns are described in Section 3.

2.0 BACKGROUND ON COMMUNITY INVOLVEMENT

The Navy developed a Moffett Field community relations plan (CRP) in May 1989. The CRP outlined specific activities based on community concerns. Since 1993, the U.S. Environmental Protection Agency (EPA) provided a technical assistance grant (TAG) to the Silicon Valley Toxics Coalition, a local environmental group. The TAG allowed the coalition to hire a consultant to assist in reviewing Moffett Field environmental documents. In addition to TAG, the Navy formed a technical review committee (TRC) in 1989, which met quarterly to discuss environmental progress at the site. The Navy later formed a restoration advisory board (RAB), which replaced the TRC in October 1994. The RAB is made up of members of the TRC and community and Navy personnel and holds monthly public meetings to discuss environmental progress at Moffett Field.

The OU5 RI report was completed in August 1993 (IT 1993b). The OU5 FS report was completed in August (PRC 1995). The proposed plan for remediation of OU5 was released to the public in October 1995. The proposed plan and FS report were made available to the public through both the administrative record and the information repository. The proposed plan was mailed to approximately 450 people on Moffett Field's mailing list on October 27, 1995. The notice of availability for the proposed plan and related documents was published in the *San Jose Mercury News* and *San Francisco Chronicle* on October 26, 1995. A public meeting was held on November 16, 1995. At this meeting, representatives from the navy, EPA, and the State of California answered questions about OU5 and supplied the basis for the selected remedy. The purpose of this responsiveness summary is to document responses to comments received during the public comment period. Comments were considered by Navy prior to selection of the final remedy for OU5 at Moffett Field, which is detailed in this ROD.

3.0 SUMMARY OF PUBLIC COMMENTS AND NAVY RESPONSES

This section contains comments received during the public comment period and public meetings, and the Navy's responses. Each comment is addressed in an effort to respond to public's concerns over the preferred remedy.

3.1 COMMENTS FROM MOFFETT FIELD RESTORATION ADVISORY BOARD (RAB) TECHNICAL, HISTORICAL, AND EDUCATIONAL (THE) COMMITTEE, NOVEMBER 16, 1995

Comment 1. Will any planned or potential Moffett Field land use be foreclosed by selecting and implementing the preferred alternative described in the proposed plan?

Response: *No. Planned or potential land uses will not be foreclosed by the selection and implementation of the preferred alternative. However, in the event of a future property transfer, implementation of appropriate land use restrictions may be necessary to disclose the property conditions to real estate transaction participants and to ensure that long-term mitigation measures or monitoring requirements are carried out and maintained.*

Comment 2. What is the relationship of the OU5 preferred alternative to the current and future operation and maintenance of the Moffett Field drain system and Building 191 pump station?

Response: *The drain system and lift station operation are essential for current land uses at Moffett Field and nearly all reasonably foreseeable future land uses. Without continued pump station operation, flooding of the northern portion of the base, including the northern end of the runways, could occur during the rainy season. Therefore, the pump station operation is taken into account as an aspect of current land use and a component of the remedy that must remain operational. The operation of the pump station will be considered in the design and implementation of the remedy, with appropriate institutional controls implemented by the federal government to assure continued operation and maintenance of the pump station and drain system.*

Comment 3. Where will the Navy memorialize its financial responsibilities if Moffett Field goes into municipal or other local government hands (for example, to a redevelopment agency), or into private hands?

Response: *Any one of several alternative methods could potentially be used in the future to convey Moffett Field property for civilian reuse, and the specific terms and conditions for such a conveyance would be negotiated and documented in the context of the actual real estate transaction. Existing legal authorities for transfer mechanisms that*

are established in the Federal Property and Administrative Services Act (40 U.S.C. Section 471 et seq.) and the Surplus Property Act (50 U.S.C. App. Section 1622) and implemented by the Federal Property Management Regulations (41 CFR Part 101-47) allow public purpose conveyances, homeless assistance conveyances, negotiated sales, competitive public sales, economic development conveyances and conveyances for the cost of environmental remediation. Sometimes special legislation is enacted by Congress and approved by the President to authorize conveyance of U.S. Government property on special terms and conditions. Any transfer of financial responsibility from the U.S. Government would be negotiated and documented as part of the terms and conditions for the conveyance.

Comment 4. The Navy's characterization of OU5 chemical distributions is based on a relatively sparse data set. The Navy interpretation of these limited data to conclude that there are two separate plumes in OU5, separated by a narrow curving band of comparatively clean aquifer, is unrealistic and is conceptually inconsistent with the Navy's historical insistence that Moffett Field groundwater chemical distributions in westside aquifers are continuous over thousands of feet.

Response: *Groundwater chemical data from at least seven monitoring wells (W3-6, W3-21, W3-24, WU5-3, WU5-4, WU5-6, and WU5-7) and four HydroPunch samples (CPTU5-13, -17, -18, and -31) indicate that two, separate contaminant plumes are present at OU5. The fact that the ratios of contaminants within the two OU5 plumes are distinctly different further supports the division of the plume areas. The Navy believes that the data at OU5 are adequate to move forward in selecting the cleanup technology. Additional data to confirm chemical concentrations and subsurface sediment distribution may be collected during the remedial design to optimize system effectiveness. Cleanup of COCs in OU5 will occur wherever groundwater is a potential drinking water source.*

Comment 5. Committee members are concerned that the potential effects, both positive and negative, of planned reinjection of treated groundwater on groundwater flow in OU5 are not adequately treated in the OU5 FS and proposed plan.

Response: *The preferred alternative in the proposed plan includes groundwater discharge, but does not specify groundwater reinjection as the discharge method. Other discharge options, such as water reuse and discharge to the storm sewer system, were evaluated during the remedial design. The selected discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.*

Comment 6. Committee members are concerned that the OU5 FS and proposed plan do not adequately address the potential regulatory barriers to planned reinjection of treated groundwater, especially in light of the complex geologic structure of OU5, the complex three-dimensional groundwater flow system in OU5, and the limited detail of the existing site characterization investigations.

Response: *The preferred alternative in the proposed plan includes groundwater discharge, but does not specify groundwater reinjection as the discharge method. The selected discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.*

The Santa Clara Valley Water District (SCVWD) has expressed support for aquifer reinjection. Please refer to general comment 5 from Mr. Thomas Iwamura of SCVWD for additional details (Section 3.16).

Comment 7. Committee members are concerned that the OU5 FS and proposed plan do not adequately reflect the uncertainties and costs associated with planned hydraulic fracturing of shallow aquifers. There do not appear to have been any field tests to confirm whether this technology will work at Moffett Field or the costs of implementing this technology at the site.

Response: *Hydraulic fracturing is not proposed as a specific component of the collection technology at this time. Groundwater collection methods, such as vertical wells, horizontal wells, and interceptor trenches, will be evaluated during the design phase. This evaluation will consider potential enhancement technologies such as hydraulic fracturing. The Navy will assess the uncertainties and costs associated with hydraulic fracturing before using this technology at OU5.*

Comment 8. The Navy's stratigraphic interpretation of OU5 is unrealistic with respect to the accuracy of delineation of preferential flow paths interpreted to be buried stream channels in shallow aquifer zones.

Response: *The Navy's conceptual depositional model for the sediments at Moffett Field is consistent with recognized regional geologic interpretations. The subsurface geology at Moffett Field is very complex and, therefore, no stratigraphic interpretation can expect to accurately define every sand body that may act as a preferential flow pathway. However, the Navy believes that the conceptual model is correct and that the larger, most dominant pathways have been identified at OU5. The Navy believes that the data at OU5 are adequate to move forward in selecting the cleanup technology.*

Comment 9. Members of the THE committee are concerned because the Navy's numerical groundwater flow and transport simulation model for OU5 is so unrealistic in several key areas that it does not appear to have been a cost-effective use of Navy resources. Committee members do not believe that the model's predictions constitute a reliable basis for design of OU5 remedial actions. Concern is heightened by the fact that the Navy has reported that it is currently developing a similar model for westside aquifers. In light of eastside groundwater flow model problems identified by the THE committee, committee members have serious concerns about the cost-effectiveness of developing a presumably similar model for a new area.

Problems with the model include, but are not limited to, inconsistency of the Navy's overall stratigraphic model for OU5 with the stratigraphic model used in the numerical model and with field data, inconsistency of hydraulic parameters in the central portion of the model compared to the edges of the model, and apparent lack of any checks to determine whether the model is capable of recreating the known chemical distribution history of OU5. The THE committee also notes that the documentation presented in the OU5 FS is insufficient to allow a complete review of the model.

Response: *All groundwater models have limitations, but models are also useful tools to understand complicated sites. The complex, nonuniform distribution of sediments at Moffett Field poses a great challenge to interpret and simplify into a numerical model.*

However, the numerical model is merely a tool to allow the scientists studying OU5 to understand how groundwater and chemicals might move in the subsurface in response to different cleanup scenarios. Too many variables (including the timing and distribution of chemical sources) exist to create a model that would be sufficiently accurate to precisely predict future conditions at OU5. The model is useful to evaluate various possible scenarios, but it is not the only factor in the overall assessment of cleanup technologies. A more basic check against the OU5 conceptual model (which is, in turn, based on knowledge of the physical and chemical characteristics of the site) is made in evaluating potential performance of any treatment technology.

Comment 10. The THE committee notes that any remedial action plan adopted for OU5 must explicitly acknowledge and account for:

1. The probable existence of more preferential flow paths than are accounted for in the Navy's current stratigraphic interpretation and numerical model;

2. The demonstrated existence of downward groundwater potentiometric gradients from time to time in parts of OU5, including the fact that no mechanism has ever been demonstrated to reliably explain the measured head reductions and downward gradients in aquifers too deep to contain known Navy drains;

3. Any requirement for continued operation and maintenance of the Navy's buried drain system and the Building 191 pump station.

Response: *Potentiometric gradients within the A1- and A2-aquifer zones at OU5 are variable. Downward gradients from the A1 zone to the A2 zone are occasionally observed, although upward gradients occur much more frequently. By contrast, potentiometric water elevations in the deeper B and C aquifers are consistently higher than elevations in the A aquifer zones. Water elevations in the C aquifer are up to 34 feet higher than the overlying A and B aquifers at OU5. Consequently, potentiometric gradients are persistently upward in direction from the B and C aquifers to the A aquifer zones.*

Head reductions in the A2 aquifer zone are observed in the area of the Building 191 lift station even though the facility drain system is located within the shallower A1 aquifer zone. A likely explanation for the observed head reductions is leakage between and A1 and A2 zones. The large head reductions generated within the A1 zone promote upward groundwater flow.

Please refer to the responses to comments 2, 8, and 9 for items 1 and 3.

Comment 11. The THE committee believes that the design, monitoring, modification, and long-term operation of groundwater cleanup systems in OU5 must recognize the greater uncertainties in site characterization that exist for OU5 compared to other typical groundwater cleanup sites in the area. OU5 groundwater cleanup systems must be more conservative than systems for better-characterized sites and the Navy must demonstrate both that key uncertainties have been identified and that adequate provisions have been made so that failure of the systems to perform adequately will be quickly discovered and remedied.

Response: *The Navy believes that the data at OU5 are adequate to move forward in selecting a cleanup technology. Additional data to confirm chemical concentrations and subsurface sediment distribution may be collected during the remedial design to optimize system effectiveness. Modifying the cleanup systems based on actual performance data will allow effective cleanup implementation while efficiently applying limited government resources.*

3.2 COMMENTS FROM MOFFETT FIELD RAB THE COMMITTEE, NOVEMBER 28, 1995

Comment 1. THE committee members feel strongly that uncertainties in the OU5 site characterization and in the design and implementation of the OU5 proposed plan are so large that the Navy and the involved regulatory agencies should commit to a formal program of ongoing public review and comment, with formal Navy response, after approval of the OU5 record of decision (ROD). Community involvement should include, but not be limited to, participation in the design of OU5 monitoring systems and in the interpretation of data collected from those systems.

This ongoing program of community review and approval should be easy to implement through the existing structure of the RAB, and is important to providing adequate public assurance that appropriate and cost-effective remedial actions will be carried out in a timely manner. A clear and strong commitment to providing a meaningful opportunity for the community to actually influence remedial design and implementation after the ROD is approved will be important to achieving community approval of the ROD. It will also help to simplify the review and approval of the

basewide FS and proposed plan. Problems with the basewide FS and proposed plan review could arise if the community feels that it needs to use the basewide FS and proposed plan review and comment process to correct problems with the OU5 FS and proposed plan.

Response: *The Navy believes that OU5 has been adequately characterized. Nevertheless, the Navy will continue to inform the RAB of progress through the remedial design and remedial action implementation in accordance with EPA and Department of Defense (DoD) guidance. The Navy will provide progress reports to the RAB members during regularly scheduled RAB meetings during the remedial design/remedial action (RD/RA) phases of the remediation. The Navy will also complete a fact sheet detailing the design which will be mailed to every person on the Moffett Field mailing list. Prior to the start of construction, the Navy will hold an open house to discuss the design and construction activities. The Navy supports and encourages continued public participation during the remedial design stage through the Moffett RAB or individual citizens or interested groups.*

3.3 COMMENTS FROM MHB TECHNICAL ASSOCIATES, REPRESENTING THE SILICON VALLEY TOXICS COALITION, DURING THE PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. In your response to Mr. Werner Gan's (comment number 1) question, you talked about the OU2-east soils. My recollection of that investigation and the decision did not include the leaching of contaminants into the aquifer. It only dealt with soil. And I think the gentleman raised an issue which I have raised in every comment I have made on this feasibility study, which is, that because there is no action on the soils because of OU2, it is not necessarily so that there does not have to be any action in the investigation and remediation of OU5.

Response: *OU2-East consists of unsaturated soils at Sites 3, 4, 6, 7, the eastern portion of Site 10, Site 11, and Site 13. The soils of these sites overlie OU5 groundwater. The OU2 remedial investigation report, published in May 1993, contains results of an evaluation of leaching from each of these sites using modeling with conservative assumptions (IT 1993b). The results of the modeling indicates no potential impacts to OU5 groundwater.*

Comment 2. I first commented on draft FS report in 1994 for OU5 and, since then, another draft that was completed. The FS report really is the technical backup document for the proposed plan, and several comments that we made on the draft are still relevant, and I feel that it should be a matter of this record.

One is the subject of potential water supplies. I think it addresses one of the questions that was raised here tonight. This issue deals with the statement Mountain View having a surplus of water for some time to come. I recommend deleting any mention of water supply of Mountain View and Sunnyvale until the state law is changed, where you do not have to clean this up, because I think it is irrelevant.

Response: *The Navy has agreed to treat the southern plume of OU5 groundwater because the water in that area satisfies the state's definition of a potential drinking water source. The Navy believes that, when the OU5 cleanup goals are achieved, the groundwater will be available for use as an additional water supply for the communities in Mountain View and Sunnyvale.*

Comment 3. The FS assumes that NASA will maintain control of Moffett for the foreseeable future. Given the mood of the Congress, I do not believe that the primary movers in determining future land use at Moffett be the members of the surrounding communities and local government institutions.

Response: *For the purpose of remedy selection for OU5, alternative scenarios for future land use at Moffett Field were considered by the Navy. A review of the remedy will be conducted periodically after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment for any potential future land uses developed as a result of either Congressional action or initiatives by the local community and/or local government institutions.*

Comment 4. The Toxics Coalition is concerned that contaminated groundwater from the northern plume area will enter the Bay via the Navy ditch or the drain system. We would hope that the Navy has a monitoring and contingency plan to detect potential exceedance of contamination and treat contaminants, if necessary.

Response: *Long-term groundwater monitoring is included in the remedy for OU5. The National Aeronautics and Space Administration (NASA) also routinely monitors the discharges from the Moffett Field storm drainage system in accordance with the applicable NPDES permit.*

No unacceptable risks to environmental receptors have been identified based on available data and groundwater modeling for OU5. The Phase II site-wide ecological assessment (SWEA) report does not identify chlorinated VOCs, which are the primary chemicals of interest at OU5, as contaminants of potential ecological concern (COPECs) in the ecological assessment areas. Also, fate and transport modeling of the OU5 plumes indicates that the groundwater in potential discharge areas (such as ditches) is not expected to exceed water quality criteria for aquatic life.

Comment 5. Is there potential for communication between the A1 and A2 aquifer zones?

Response: *Hydraulic communication between the A1- and A2-aquifer zones is possible at OU5. The potential for communication is small because the interval between the A1- and A2-aquifer zones is characterized by fine-grained sediments, such as silt and clay, that do not readily transmit water. However, the sediment distribution in this horizon, as throughout Moffett Field, is highly nonuniform and localized areas may exist which have a greater potential for hydraulic connection. The proposed remedy involves groundwater extraction from the A1-aquifer zone, which will promote upward migration of water from the A2- to the A1-aquifer zone, and downward migration from A1 to A2 will be inhibited. The cleanup strategy also will involve groundwater monitoring of the A2-aquifer zone to evaluate potential movement of groundwater from the A1- to the A2-aquifer zone.*

Comment 6. My comment on the proposed plan is that you need to analyze reasonable possibilities for future land use, and what happens if the drain system is turned off, if the runways are no longer needed, and I think all the contingencies go into plan.

Response: *The drain system and lift station operation are essential for current land uses at Moffett Field and nearly all reasonably foreseeable future land uses. Without continued pump station operation, flooding of the northern portion of the base, including the northern end of the runways, could occur during the rainy season. Therefore, the pump station operation is taken into account as an aspect of current land use and a component of the remedy that must remain operational. The operation of the pump station will be considered in the design and implementation of the remedy, with appropriate institutional controls implemented by the federal government to assure continued operation and maintenance of the pump station and drain system.*

Comment 7. I would hope that air emissions control on any cleanup technology be required; and I recommend that the Navy adopt a no-emissions policy. There are too many uncertainties in terms of the amount of emissions that are going up in the air already from unregulated sources to warrant not doing that. I think that has been a broad based community concern, at least as expressed to me through the Toxics Coalition.

Response: *Navy will comply with the Bay Area Air Quality Management District (BAAQMD) regulations on air emissions.*

Comment 8. I note that the northern part of this plume flows under the old golf course. Now that we have not talked about is that there are two additional landfills that were discovered late in the investigation in the golf course area. So they will be addressed in a site-wide ROD, but I hope that we don't foreclosure any option about cleaning those up by the options you take now.

Response: *Two sites, Golf Course Landfills 2 and 3, were added to the list of IRP sites following an additional investigation in the summer of 1994. These sites are being investigated as part of the site-wide FS. The remedial actions being taken at OU5 will not prohibit any future potential remedial actions at the two landfills. As specified in this ROD, a groundwater collection and treatment system is proposed for the southern area at OU5. The northern area does not require remediation because it does not satisfy the state's criteria as a potential drinking water source and poses no unacceptable risk to human health and the environment. Based on the results of the site-wide RI, Navy will evaluate whether remedial actions should be undertaken at Golf Course Landfills 2 and 3.*

3.4 COMMENTS FROM MAYOR OF THE CITY OF MOUNTAIN VIEW, TO DONALD CHUCK, NOVEMBER 30, 1995

Comment 1. The City of Mountain View is vitally interested in the cleanup efforts currently underway at Moffett Federal Airfield. It is the City's position that OU5 and all contaminated sites at Moffett Federal be cleaned up to a level that will allow for the maximum flexibility for future land use and meet all health and safety standards.

Response: *The Navy acknowledges the city's continued interest in the cleanup activities at Moffett Federal Airfield and at OU5 in particular. Although no one can accurately predict the future for Moffett Field, the Navy is assuming that OU5 will be used for residential purposes, which is the most conservative scenario. The Navy has selected a remedy that will attempt to meet this cleanup goal. However, cleaning up the groundwater to such low levels may not be technically practicable because of the nature of the chemicals involved and the geologic conditions at OU5. Land uses that require the use of groundwater at OU5 as drinking water would not be permitted during the cleanup process.*

Comment 2. The City is concerned about the estimated length of the project (50 years) and the institutional controls that will be placed on the area surrounding OU5. Is there a cleanup technology that can remove the contaminants from the groundwater in a shorter period of time? What institutional land use controls will be placed on the area surrounding OU5? Will there be any restrictions on the types of potential future land uses?

Response: *Navy evaluated other cleanup technologies and selected the proposed cleanup method that involves collection and treatment by an air stripping system. It is one of the pump-and treat technologies and has been used at several Superfund sites. It has been proven to be an effective treatment process for removing volatile organic compounds (VOCs) from contaminated groundwater. The long restoration time of 50 years or more is not attributed to the treatment technology. The removal rate of contaminants depends on the rate of desorption of contaminants from OU5 soils which is mainly silt and clay material. The slow rate of desorption will prolong the restoration time at OU5.*

Based on current information available to the Navy, NASA is expected to maintain control of Moffett Field for the foreseeable future. However, in the event of a transfer prior to attainment of cleanup goals, appropriate covenants and restrictions to preclude use of groundwater at OU5 as drinking water may be required.

Comment 3. The City of Mountain View also has concerns regarding the effect the plumes could potentially have on the Bay and aquatic life of the Bay. Is it possible for the plumes to contaminate the Bay in any way? If so, how will the Navy remediate this problem?

Response: *It is highly unlikely that OU5 chemicals will enter San Francisco Bay. The chemical nature of VOCs favors rapid volatilization from surface water if any VOCs were to discharge to surface water in facility drainage ditches. Fate and transport modeling of the OU5 plumes indicates that the groundwater in potential discharge areas (such as ditches) is not expected to exceed water quality criteria for aquatic life. No unacceptable risks to environmental receptors have been identified based on available data and groundwater modeling for OU5. The Phase II SWEA report does not identify chlorinated VOCs, which are the primary chemicals of interest at OU5, as COPECs in the ecological assessment areas.*

Long-term groundwater monitoring also is included in the remedy for OU5 to monitor the positions of the OU5 plumes. NASA also routinely monitors the discharges from the Moffett Field storm drainage system in accordance with the station's NPDES permit.

Comment 4. The City has concerns regarding the Navy's long-term commitment for the cleanup of Moffett Federal Airfield. How will the Navy continue to provide adequate financial resources for the long-term cleanup of Moffett Federal Airfield and OU5?

Response: *The Department of Defense will be obligated to seek Congressional appropriations adequate to ensure continued funding in sufficient amounts to allow the Navy to meet its long-term cleanup obligations.*

3.5 COMMENTS FROM DR. JACQUES GUERTIN, DURING THE PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. What would be the risk from drinking the maximum and mean concentration of TCE and 1,2-DCE at the southern plume?

Response: *Risks and hazards associated with chemicals of concern (COC) risks are calculated using the 95 percent upper confidence limit (UCL) of the arithmetic mean concentration unless that value is greater than the maximum value, in which case the maximum concentration is used. Average concentrations are not used to calculate risks or hazard indices based on EPA guidance (1989). Average risks are calculated*

using average exposure parameters combined with the 95 percent UCL concentration (or maximum concentration, as described above). Based on that, the reasonable maximum exposure (RME) cancer risk range for drinking water at the southern plume is 1.4×10^{-4} to 7.3×10^{-4}. Based on average exposure parameters, the cancer risk ranges 2.5×10^{-5} to 1.7×10^{-4}. The chemical 1,2-DCE is a noncarcinogen and risks are not calculated for noncarcinogens. The noncarcinogenic RME hazard quotient for drinking water in the southern plume ranges 1 to 5.4. Based on average exposure parameters, the noncarcinogenic hazard quotient ranges 0.53 to 3.1. The OU5 RI describes the results in greater detail.

Comment 2. What is the drinking risk at the maximum contaminant level (MCL), that is, 5 ppb TCE and 6 ppb 1,2-DCE?

Response: MCLs are maximum permissible levels of contaminants in water that are delivered to any user of a public water system. They are developed by EPA and take into account technical and economical considerations as well as risk. Using the exposure parameters presented in the OU5 RI, carcinogenic risk from groundwater ingestion is 9.0×10^{-7} for TCE at 5 ppb. This is below EPA's acceptable range of 1.0×10^{-6} to 1.0×10^{-4}. The hazard quotient for 1,2-DCE at 6 ppb is 2.0×10^{-2}.

Comment 3. What is an acceptable risk? Is it 1 in a million cancer risk?

Response: The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states that a cancer risk ranging from 1.0×10^{-6} to 1.0×10^{-4} is considered acceptable. However, EPA Region IX reserves the right to take site-specific risk reduction or remedial measures when contaminant concentrations are estimated to pose risks in this range.

Comment 4. What is the risk from the northern plume?

Response: The risk assessment conducted for OU5 did not consider a human health risk for the northern plume because it can not be used as a drinking water source. The northern plume fails the state's definition of potential drinking water source. The risks evaluated were for occupational and ecological receptors. The risk assessment indicated that there were no unacceptable risks to site workers and ecological receptors.

Comment 5. I want to say that the pump and treat approach, while it looks reasonable, do not be surprised that it may not work quite as well as you hope, because the contaminants may be strongly adsorbed into clay, in which case it will take an awfully long time to pull them off. So do not be surprised if you do not get this 100 ppm or so to 5 ppb. You might only get halfway, or then you have an asymptotic situation, perhaps.

Response: *Pump-and-treat systems are currently being used at several Superfund sites and are effective for treatment of VOCs. However, given the geology of the site at OU5, the remediation time may be prolonged.*

Comment 6. Can one obtain the risk reports? What is the cost?

Response: *These documents are available for review at the City of Mountain View Public Library.*

3.6 COMMENT FROM MS. MARY NICHOLS, A RESIDENT OF MOUNTAIN VIEW DURING PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. I am projecting ahead. How long is this process projected to take, this air stripping process? Does that totally exclude that plume area from development by the cities as the Navy withdraws and somebody else takes over? Is there going to be a fence around there, or is it still developable with industrial design?

Response: *Based on modeling results, the Navy estimates that it will take at least 50 years to completely attain the stated cleanup goals. The operation and maintenance of a groundwater treatment system will not preclude development of the area.*

3.7 COMMENTS FROM MR. WERNER GANS DURING THE PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. Isn't there also contaminations of the ground over there at OU5?

Response: *There are several sites on the eastern side of Moffett Field that overlie OU5. The Navy is implementing cleanup at many of these sites. Many of these sites do not pose unacceptable risk to human health and the environment and no further action is planned, based on risk assessment.*

However, further investigation and action are underway at some sites. Specifically, a cleanup action is underway at Site 5, a fuel farm, under the Navy's petroleum sites program. Sites 1 and 2 landfills in the northeastern part of Moffett Field are being investigated under operable unit 1 (OU1). Sites 22 and 23 landfills are being investigated under the site-wide feasibility study.

There are also tank sites, such as Sites 15 and 19, at which the Navy is conducting tank and contaminated soil removals.

Comment 2. Are those sources for additional contamination of the aquifer?

Response: *The sites described above were originally part of OU2, which consisted of unsaturated soils at Moffett Field. During the remedial investigation, an estimate of the potential of chemicals in soils at these sites to leach and impact groundwater was made. The results indicated the impact to be minimal and thus that no further action was necessary, with the exception of the petroleum tank sites.*

Comment 3. Also, I heard those aquifers and contaminations going all the way to the east under the Lockheed plant.

Response: *The Navy's continuous monitoring does not indicate this statement to be accurate. The plume that exists in the northern and southern areas at OU5 is well defined by the network of monitoring wells installed in the area. In addition, the direction of groundwater flow is toward the north, and not toward the east where the Lockheed plant is located.*

Comment 4. I live over in Sunnyvale, a few blocks away. There is a MEW Industrial Park, and there are semiconductor plants over there that have leaking tanks and contaminated groundwater, and I have been going through an air stripping process over there for five years at least. I was wondering if you folks are in contact with the people who are doing that, in order to get some lessons that were learned. The state is involved in there, too. I think it would be worthwhile to find out the lessons learned from it.

Response: *The Navy is currently operating an air stripping system at the western side of Moffett Field. Data from the operation of that system will be evaluated for use of the operation of the air stripper planned for OU5. The Navy is in communication with representatives from the MEW site south of Moffett Field. The groundwater under the MEW site contains a similar solvent contamination and flows under Moffett Field. An air stripping system has been running at the site for several years. The Navy has received information on the performance of the air stripper at the MEW site and will also evaluate information from operation of other air strippers at sites throughout the country.*

Comment 5. Over in the Sunnyvale area, somebody comes along and takes a sample and takes it over wherever the samples go. Is there any way of making those measurements automatically at the edge of the aquifer sites and saving all that labor of opening up the caps.

Response: *There are instruments on the market that automatically measure levels of contaminants in samples. However, these instruments are often complex and expensive to run and maintain. The Navy finds the current sampling and analytical procedures quicker, inexpensive, and more reliable.*

Comment 6. If I understand you correctly, only aquifer A1 is contaminated. Is there a risk of A2 also getting contaminated from A1?

Response: *The potential for communication of the two aquifers exists, but is highly unlikely. Monitoring of the A2 aquifer shows no indication of contamination. The Navy, however, will continue to monitor the A2 aquifer. In addition, the selected remedy which involves groundwater extraction from the A1 aquifer zone will promote upward migration of groundwater from the A2 to the A1 aquifer and inhibit downward migration of groundwater and thus contamination from the A1 to the A2 aquifer.*

Comment 7. It would appear that the cleanup of aquifer A1 is a very low priority project since that water will probably never be used and is not likely to contaminate aquifer A2. Therefore, the realistic action appears to be to just monitor the condition since it does not spread. As a taxpayer, which we all are, and if there is only a low level of risk of

having additional contamination of the other aquifers, then I would say only watch it, but do not clean it up. It seems like a very large expense to go and clean up the water which you probably are never going to use. The probability of a shallow aquifer ever being used as drinking water is about zilch; or if it is, this valley is in big trouble. Why waste money to clean up a site, an aquifer, which you will not use, when there are a lot more important things that need to be cleaned up?

Response: *The Navy realizes that the contaminated A1-aquifer zone will not likely be used for drinking water. Moreover, the potential for migration of contaminants from A1- to A2-aquifer zones is low. In light of these facts, the Navy had proposed other alternatives that do not involve treatment. However, the A1-aquifer zone in the southern area is considered a potential drinking water source by the state. Therefore, the Navy, with the concurrence of the regulatory agencies, opted to select an active cleanup method for the A1-aquifer zone.*

Mr. Mike Gill of the U.S. EPA, Region IX, also responded to this comment and stated that cleaning up this aquifer is considered a good investment even though it is an expensive investment, because the aquifer is considered a potential drinking water source and because of the status of water in California. In EPA's view there is a possibility that someday that water may be used as a potable source.

3.8 COMMENT FROM MR. ROBERT STRENA DURING PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. I just wanted to ask about one thing that appeared in the paper today, and that is why I am bringing it up. The paper says:

"Last year Navy officials, along with several Silicon Valley industrial companies, agreed to a multimillion dollar cleanup plan to deal with the biggest chunk of contamination, a toxic plume on the western part of the airfield. That plume has crossed on the other side of Highway 101 and joined with another contaminated site in the industrial area, once owned by the Industrial Zone."

That does not seem to be what I have heard earlier. I am curious if anyone will address that, since that was on the paper today.

Response: *The Navy would like to make a correction on the statement made in the newspaper. The statement quoted by the commentor is incorrect. The plume actually emanates from the MEW site, south of Moffett Field and has traveled toward Moffett Field. In other words, the plume is flowing from the industrial site into Moffett Field and not vice versa, as the newspaper claims.*

3.9 COMMENT FROM MR. JOHN WELLBOURN OF CITY OF MOUNTAIN VIEW DURING PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. On your discharge of the liquid, where does that go?

Response: *The Navy's selected discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.*

3.10 COMMENT FROM MR. MIKE GILL OF THE U.S. EPA, REGION IX REGARDING DISCHARGE METHOD

Comment 1. How long of a period will it be before you select a discharge option? Six months?

Response: *The Navy has selected the discharge method. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.*

3.11 COMMENT FROM MR. P. CHOKKALINGAM OF LOS ALTOS REGARDING DISCHARGE METHOD

Comment 1. I think one thing that comes up today, the discharge water option process is water reuse. Maybe they can recycle the water for another purpose and not waste it.

Response: *The Navy has selected the discharge method. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.*

3.12 COMMENT FROM AN ANONYMOUS PERSON DURING PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. Cost, rankings, and criteria aside, is it not true that for any specific site application there is no single one cleanup science that can be totally or 100 percent effective or even close to it?

This is all statistics and hyperbole that are all conjecture. No site and area of this kind and size has probably ever been done before. Likewise, the geologic strata and topography of the site and years of use will very greatly influence any degree of success of any type of cleanup technology known today.

Unfortunately, to be close to any degree of success in cleanup with today current technology, you would have to have use of most or all technologies now available, for both above and below ground cleanup.

Unfortunately, costs would be astronomical, so you will only get a token acceptable cleanup.

Response: *In most cases, more than one type of cleanup technology (which is an application of science) is required to mitigate contamination at a site. However, there are cases at CERCLA sites where a single type of cleanup technology was effective. The issue here is not whether it was 100 percent effective or not. The cleanup technology should be able to meet all the criteria specified in the NCP in order to protect humans and the environment from risks that are not unacceptable.*

Due to the geology of the site and the low desorption rate of contaminants, it may not be possible to achieve all the cleanup goals. At that point and time, the Navy may look at other remedies that protect human health and the environment.

Each site is unique and has its own physical and chemical characteristics and has different area and size. There are other NPL or non-NPL sites that are comparable to OU5 in size and area. But the extent of contamination at OU5 is different and is therefore addressed accordingly. The commentor makes a good point in that the site strata and extent of contamination over the years will influence the success of the cleanup effort at OU5. The selected remedy, treatment of groundwater using air stripping, is anticipated to achieve the cleanup goals over the duration of the remediation period.

3.13 STATEMENT FROM MS. CYNTHIA SIEVERS, REPRESENTING THE LEAGUE OF WOMEN VOTERS OF LOS ALTOS, LOS ALTOS HILLS, AND MOUNTAIN VIEW, AND OF SUNNYVALE-CUPERTINO DURING PUBLIC MEETING, NOVEMBER 16, 1995

Commended the Navy for its concern about meeting community standards and its efforts to involve the public in the process of cleaning up Moffett Field, and specifically supported the cleanup effort at OU5.

3.14 COMMENT FROM MS. CHRISTINA M. SCOTT, COST COMMITTEE CHAIR, MOFFETT FIELD RAB, TO MR. DON CHUCK, NOVEMBER 21, 1995

Comment 1. Capital Costs: Construction cost - Where is the construction management estimate? Please evaluate the inconsistencies between using secondarily contained transfer piping, stainless steel walls and a low budget air stripper. Where are costs for well headwork and vault boxes?

Capital Costs: Indirect Costs - What will the design cost? Will it be phased to include studies and field work to define stream channel locations, reinjection feasibility, and pump tests? Will there be additional modeling costs? What did the FS modeling effort cost? When will an effective monitoring system be designed and installed?

Annual O & M Costs: Please include the groundwater extraction fee from the Santa Clara Valley Water District. Reporting costs for permit compliance monitoring and effectiveness monitoring should be included. Project management expenses of the remediation operations needs to be estimated.

Response: *The Navy will develop a more comprehensive cost opinion as part of the remedial design and remedial action (RD/RA). The Navy has prepared cost estimates for OU5 as part of the FS using EPA's Remedial Action Costing Procedures Manual and Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. The cost estimate in the FS report contains a detailed cost breakdown of all items the Navy believed to be necessary. According to the guidance, the cost estimate is intended to provide an order-of-magnitude or lesser level of accuracy falling within the range of +50 percent to -30 percent, not to include every item imaginable.*

3.15 COMMENTS FROM MR. DAVID GLICK, MEMBER OF THE MOFFETT FIELD RAB THE COMMITTEE TO MR. STEPHEN CHAO, NOVEMBER 25, 1995

Comment 1. The review of the site geology identifies that the project area is underlain by thinly bedded lenses of permeable silty sand, sand, clayey sand, and gravelly sand within a larger low-permeable silty clay deposit (referred to as the A1 and A2/B1 aquifer). Based on regional and local investigations, and review of the findings of remedial actions on locally adjacent properties, these thinly bedded lenses of more permeable sediments are often connected and laterally continuous for several hundreds of feet. However, it is also common for these units to terminate within several tens of feet from particular borings/wells where they were observed. These thin channel units are also generally found to be sinuous in nature (as would be expended in a low-energy depositional environment of the bay margin) and not direct linear features (suggestive of higher energy depositional environments).

Similarly, the vertical connectivity of these interbedded units has also been demonstrated to exist (such that water in the sediments of the A1-aquifer zone does have some communication of waters in the A2/B1 sediments).

With this regional and local knowledge, it is not surprising to find by review of the surficial hydrogeologic maps and cross sections presented in the OU5 feasibility study report that correlation of these low-permeable and higher-permeable sediments is incomplete where existing data are present. This is evidenced in part by the apparent difficulty to extrapolate the continuity of sediments within an area of closely spaced borings. However, it is more surprising to find that these highly interbedded and

sinuous units are in fact extrapolated as "linear" and continuous features where these is an absence of data. The "generalized interpretation" and apparent extrapolation of continuous low-permeable sediments in the area of low data, and more interestingly the absence of inclusion of higher-permeable sediments as one would expect to be present, is not consistent with the "interpretation" presented where real data exist or used elsewhere on Moffett Field.

Response: *The Navy's conceptual depositional model for the sediments at Moffett Field is consistent with recognized regional geologic interpretations. The subsurface geology at Moffett Field is very complex and, therefore, no stratigraphic interpretation can expect to accurately define every sand body that may act as a preferential flow pathway. However, the Navy believes that the conceptual model is correct and that the larger, most dominant pathways have been identified at OU5. The Navy believes that the data at OU5 are adequate to move forward in selecting the cleanup technology.*

Comment 2. The data collected to date do not provide conclusive evidence regarding the vertical connectiveness of the A1 and A2/B1 aquifers within the project area particularly with respect to the confidence suggested that the contaminants are hydraulically isolated in the A1 aquifer. This irregularity is also raised by the absence of A2/B1 data throughout the project area and at crucial locations.

Response: *Hydraulic communication between the A1- and A2-aquifer zones is possible at OU5. The potential for communication is small because the interval between the A1- and A2-aquifer zones is characterized by fine-grained sediments, such as silt and clay, that do not readily transmit water. However, the sediment distribution in this horizon, as throughout Moffett Field, is highly nonuniform and localized areas may exist which have a greater potential for hydraulic connection. The proposed remedy involves groundwater extraction from the A1-aquifer zone, which will promote upward migration of water from the A2- to the A1-aquifer zone, and downward migration from A1 to A2 will be inhibited. The cleanup strategy also will involve groundwater monitoring of the A2-aquifer zone to evaluate potential movement of groundwater from the A1- to the A2-aquifer zone.*

Comment 3. The "hydrogeologic model" presented to date appears to be founded upon the combined interpretations of high-data areas and low-data areas, as is typical with modeling. However, the differences in the interpretations regarding the highly interbedded nature of the sediments, the absence of inclusion of other high-permeable sediments in low-data areas, and the suggested "linearity" of the sediments and channel deposits suggests that the model does not properly reflect the highly variable site conditions. This conclusion is also suggested by the forced low-flow and no-flow boundary conditions and truncation of sediments/water flow of the model. Based on a preliminary view, the appears that the model boundary conditions were forced to equate with local conditions but it does not appear that the model as presented would generate conditions equivalent to the natural site conditions without being manipulated. This is also of concern with respect to the model's ability to evaluate the connectivity of the A1 and A2/B1 aquifer since there is very little data (which has been extrapolated to great extent without any verification).

Response: *All groundwater models have limitations, but models are also useful tools to understand complicated sites. The complex, nonuniform distribution of sediments at Moffett Field poses a great challenge to interpret and simplify into a numerical model. However, the numerical model is merely a tool to allow the scientists studying OU5 to understand how groundwater and chemicals might move in the subsurface in response to different cleanup scenarios. Too many variables (including the timing and distribution of chemical sources) exist to create a model that would be sufficiently accurate to precisely predict future conditions at OU5. The model is useful to evaluate various possible scenarios, but it is not the only factor in the overall assessment of cleanup technologies. A more basic check against the OU5 conceptual model (which is, in turn, based on knowledge of the physical and chemical characteristics of the site) is made in evaluating potential performance of any treatment technology. The Navy will provide additional information concerning the details of the OU5 model upon request.*

Comment 4. The groundwater data presented in previous reports illustrate that the existing surface water drainage ditches, drainage channels, and the airfield drainage system are primary hydraulic controls for the A1 aquifer in portions of the project area; however, these existing hydraulic controls do not appear to have been included in the

hydrogeologic model or in the proposed remedial plans. The significance of these man-made hydraulic controls seems to have been discounted; however, any change (either a decrease or increase in pumping of groundwater) will have a direct impact on the hydraulic conditions beneath the project site. Since hydraulic control and protection of the underlying groundwater are primary functions of the remedial design, maintenance of the man-made hydraulic controls must be accounted for in the remedial design and reflected in the cost allocations.

Response: *Groundwater flow into ditches and other subsurface conduits was included in the OU5 groundwater model. The Navy ditch and the northern portion of Marriage Road ditch were modeled as groundwater discharge areas. Drainage into subsurface sanitary sewer lines at OU5 also was included in the numerical model. Section 2.1 in Appendix E of the final OU5 FS report contains additional details concerning drainage areas incorporated into the groundwater model. Continued operation of the airfield drainage system is essential to nearly all future land uses at Moffett Field. The subdrain system is necessary to prevent surface flooding and has an effect on the groundwater flow direction and velocity in the northern part of the facility. The subdrain system and all other existing hydraulic control will be taken into account in the design and implementation of the remedy.*

Comment 5. With these comments and concerns in mind, it is my opinion that although additional site investigation would benefit the understanding of the hydraulic conditions, provide significant information for the hydraulic model (particularly the ability to improve the agreement with natural conditions) and further demonstrate the extent of the known contaminant plume, these investigations are not necessary to proceed with remedial action. It is important, however, that the remedial systems and design not be based on the "simplified" hydrogeologic conditions suggested by the hydraulic model but provide for significant variations to exist. Furthermore, there is very little data to definitively confirm the lateral and vertical extent of the groundwater plumes. These issues can be in part resolved with the provision for additional borings and wells in the design/installation phase of work to either: (1) confirm the accuracy of the interpreted site conditions/model, (2) provide for improvements of the known/inferred stratigraphic conditions, (3) provide for the verification of the extent of contaminant plumes, and (4) to provide for installation of additional groundwater extraction and/or groundwater monitoring wells to improve the effectiveness of the remedial system.

It is further recommended that additional groundwater monitoring wells be installed in the A1 and A2/B1 aquifers to monitor the effectiveness of the proposed remedial action, since the existing wells provide for large areas where effects of the remedial action could only be speculated upon. Speculation, let alone modeling, is not considered to be a substitute for direct verification.

Response: *Additional data to confirm chemical concentrations and subsurface sediment distribution may be collected during the remedial design to optimize system effectiveness. As the remedy is implemented, the Navy will evaluate what, if any, additional confirmation data are need to enhance system operation. Modifying the cleanup systems based on actual performance data will allow effective cleanup implementation while applying limited government resources.*

Comment 6. With regard to the proposed reinjection of the extracted/treated groundwater, it is recommended that additional reuse considerations be critically/seriously evaluated. Based on the known site conditions, reinjection of the volume of water anticipated to be derived from this system is going to be very difficult, particularly since the actual stratigraphic conditions have not been confirmed/verified.

Response: *The preferred alternative in the proposed plan includes groundwater discharge, but does not specify groundwater reinjection as the discharge method. Other discharge options, such as water reuse and discharge to the storm sewer system, were evaluated during the remedial design. The Navy's selected discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.*

Comment 7. Use of the proposed hydrofracturing to improve the flow conditions will result in changes for groundwater extraction, water injection, contaminant migration, and very probably changes in the effective stress conditions of the aquifer sediments which could result in increased regional and local settlement, soil heaving, localized settlement and generation of distress of critical structures, and other geotechnical engineering conditions not evaluated to date. It is recommended that serious consideration of the applicability of this technology for the specific project site conditions and technical studies be performed prior to proceeding further with this concept.

Response: *Hydraulic fracturing is not proposed as a specific component of the collection technology at this time. Groundwater collection methods, such as vertical wells, horizontal wells, and interceptor trenches, will be evaluated during the design. This evaluation will consider potential enhancement technologies such as hydraulic fracturing. The Navy will assess the uncertainties and costs associated with hydraulic fracturing before using this technology at OU5.*

Comment 8. It is suggested that the cost estimates be critically reviewed for completeness and should include: the labor charges for technical and professional individuals necessary to be on site to install the proposed wells, professional labor charges to oversee the installation of the remedial system, the labor charges for preparation and submittal of permits let alone the labor for filing the required boring logs and preparation of technical drawings depicting the installed system, the labor charges for preparation of installation and monitoring reports, and contractor mark-up and/or profit on materials, equipment, and subcontractors/consultants.

Response: *The Navy will develop a more comprehensive cost estimate as part of the RD/RA. The Navy has prepared cost estimates for OU5 as part of the FS using EPA's Remedial Action Costing Procedures Manual and Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. The cost estimate in the FS report contains a detailed cost breakdown of all items the Navy believed to be necessary.*

3.16 COMMENTS FROM MR. TOM IWAMURA OF THE SANTA CLARA VALLEY WATER DISTRICT AND MEMBER OF THE MOFFETT FIELD RAB THE COMMITTEE TO MR. DON CHUCK, NOVEMBER 28, 1995

The following comments were provided on the OU5 FS report.

Comment 1. We concur that the selected pump-and-treat alternative of remediation, as presented in the public meeting announcement of October/November 1995, is the most suitable of the alternatives that were studied for the OU5 plume. However, we believe more field investigations would have to be performed to further define the stratigraphic conditions, particularly to the delineation of ancient subsurface aquifer channels of the A1 and A2 aquifers, better establish the hydraulic relationship between the A1 and A2 aquifers, and better characterize the A1 aquifer plume and further perform studies of the potential contamination of the A2 aquifer.

Response: *The Navy believes that the data at OU5 are adequate to move forward in selecting the cleanup technology. Additional data to confirm chemical concentrations and subsurface sediment distribution may be collected during the remedial design to optimize system effectiveness. As the remedy is implemented, the Navy will evaluate what, if any, additional confirmation data are need to enhance system operation. Modifying the cleanup systems based on actual performance data will allow efficient cleanup implementation while applying limited government resources.*

Comment 2. For remediation, a more realistic number and pattern of extraction and injection could be developed. This would be based upon a predesign phase field exploration developed data. We believed the currently proposed conceptually estimated remediation pattern may not be realistic, as it is based upon undocumented modeling assumptions.

Response: *The Navy intends to collect additional information data, as needed, to enhance system operation. Throughout this process, system performance data will guide modifications needed to optimize the operation of the remedial system.*

Comment 3. We are concerned that the hydraulic relationship between the A1 and A2 aquifers have not been established. Drainage pumping at Building 191 shows that both the A1 and A2 aquifers are affected. This leads to the conclusion that the two aquifers are connected, perhaps through a leaky aquitard that separates them.

The three aquifer tests at three locations of the A1 aquifer described in the remedial investigation report (IT 1993) indicated the A1 aquifer to be unconfined. However, the interpretation of these tests do not indicate whether the vertical flow of waters from storage was solely from the upper overlying "leaky" aquitard, or from both the overlying leaky aquitard and the underlying leaky aquitard. In order to establish better the true property of the separating aquitard, aquifer test(s) would have to be performed also in the A2 aquifer. Furthermore, the three locations of the aquifer tests of the A1 aquifer were not optimally located to provide sufficient data for the model simulation inputs as none were located within a significant channel deposit, but in locations where the aquifer deposits were relatively thin.

Response: *Hydraulic communication between the A1- and A2-aquifer zones is possible at OU5. The potential for communication is small because the interval between the A1- and A2-aquifer zones is characterized by fine-grained sediments, such as silt and clay, that do not readily transmit water. However, the sediment distribution in this horizon, as throughout Moffett Field, is highly nonuniform and localized areas may exist which has a greater potential for hydraulic connection. The proposed remedy involves groundwater extraction from the A1-aquifer zone, which will promote upward migration of water from the A2- to the A1-aquifer zone, and downward migration from A1- to A2-aquifer zone will be inhibited. The cleanup strategy also will involve groundwater monitoring of the A2-aquifer zone to evaluate potential movement of groundwater from the A1- to the A2-aquifer zone.*

Comment 4. The determination of the presence of solvents in the A2-aquifer zone is incomplete as this deeper zone was explored at only seven locations. We are concerned that the higher levels of solvent detected in the earlier phases of exploration of the A1-aquifer zone may have migrated into the A2-aquifer zone, accounting for the lower concentrations in the A1-aquifer zone as noted in the present exploration. If this were the case, extraction remediation would also have to be performed in the A2-aquifer zone. Additional testing of the A2-aquifer zone would also provide a better concurrent documentation of potential vertical gradient between the A1- and A2-aquifer zones, in addition to setting a better monitoring program for the A2-aquifer zone as remediation progresses.

Response: *The Navy believes that the data at OU5 are adequate to move forward in selecting the cleanup technology. In addition, the proposed remedy involves groundwater extraction from the A1-aquifer zone, which will promote upward migration of water from the A2- to the A1-aquifer zone, and downward migration from A1- to A2-aquifer zone will be inhibited. The cleanup strategy also will involve groundwater monitoring of the A2-aquifer zone to evaluate potential movement of groundwater from the A1- to the A2-aquifer zone.*

Modifying the cleanup systems based on actual performance data will allow efficient cleanup implementation while applying limited government resources.

Comment 5. In regard to the reinjection of treated wastewater into the A1 aquifer, the Santa Clara Valley Water District (District) would encourage such an effort. We do so to encourage water conservation and to expedite the cleanup. We believe that further studies would have to be performed, including a field test to check the feasibility of such an effort.

Response: *The preferred alternative in the proposed plan includes groundwater discharge, but does not specify groundwater reinjection as the discharge method. Other discharge options, such as water reuse and discharge to the storm sewer system, were evaluated during the remedial design. The discharge method for OU5 is water reuse for irrigation purposes at the Moffett Field golf course. If water reuse is not possible, the discharge will be sent to a local POTW or local off-site surface waters under an NPDES permit.*

3.17 SPECIFIC COMMENTS RECEIVED FROM MR. TOM IWAMURA

Comment 1. Under Section 4.1.3 of the feasibility report under Maintenance of Aquifer Beneficial Uses, page 94, the statement "...prolonged pumping from shallow water-bearing units resulted in land subsidence (2 to 8 feet were recorded at Moffett Field)..." is incorrect as land subsidence resulted from overdrafting of the deep confined aquifers.

Response: *The text of this section should indicate pumping from the deep, not shallow, water-bearing units resulted in land subsidence.*

Comment 2. On our well location map, we noted well 06S2W12N01 located at the northern edge of the fuel farm french drain site. Since this well is considered to be abandoned, we request that this well be properly destroyed in accordance with District Ordinance No. 90-1, Well Standards. This well is described in "Research Report, Potential Conduits Investigations, Moffett Air Station, Moffett Field, California" by Kennedy/Jenks/Chilton, January 1988. I have attached pertinent excerpted pages from this report. The Navy or its consultant would have to obtain a well destruction permit from the District prior to the performance of the well destruction.

Response: *The Navy's contractor, International Technology Corporation (IT), conducted numerous field surveys and shallow excavations in fall 1990 to locate this well. No evidence of a well was found. Results of this investigation are contained in the Blockage Removal and Abandonment Report, Naval Air Station Moffett Field, California dated May 1991. Therefore, the Navy believes that the earlier report of an abandoned well is incorrect and no further action is planned.*

Comment 3. We are also represented on the RAB and the THE committee of the RAB. We substantially concur with the comments brought forth by the committee in their letter to Mr. Stephen Chao dated November 16, 1995.

Response: *Please refer to the responses to the THE committee comments.*

3.18 COMMENTS FROM MR. STEWART MCGEE, OF THE MOFFETT FIELD RAB THE COMMITTEE, REPRESENTING THE CITY OF SUNNYVALE AND SPECIFICALLY ROBIN PARKER, DURING PUBLIC MEETING, NOVEMBER 16, 1995

Comment 1. The City of Sunnyvale would like to go on record as agreeing with a lot of the statements and questions raised by the November 16th letter from Dr. Jim McClure to Stephen Chao.

Response: *Please refer to responses to Jim McClure's comments.*

Comment 2. One issue is that it is very critical for the City of Sunnyvale that the U.S. Navy maintain financial support for the cleanup and other remedial actions adopted for OU5, even after the land may be transferred to either a local agency or another entity.

Response: *The Department of Defense will be obligated to seek Congressional appropriations adequate to ensure continued funding in sufficient amounts to allow the Navy to meet its long-term cleanup obligations.*

Comment 3. Alternative methods for cleanup, the groundwater monitoring alternative in 5A, collection, air stripping, and discharge, these are the preferred methods of remediation for the City of Sunnyvale for OU5, even though, as Dr. McClure pointed out, the model may not be capable of recreating all the known chemical distribution history of OU5, Sunnyvale prefers those particular methods be into effect.

Response: *The Navy will implement the selected remedy at OU5. The implementation schedule is described in the OU5 RD/RA work plan.*

Comment 4. It is crucial that the nature and extent of contamination be continually evaluated with respect to the remedial methods chosen for OU5, the groundwater monitoring and air stripping, and discharge.

It is also important that a comparison between the baseline contamination values and the suspected reduced values resulting from this remedial cleanup method be maintained.

Response: *As part of the remedy, samples will be taken for the purpose of determining whether cleanup up goals specified in the ROD are achieved. The details for the sampling and analysis activities will be described in the long-term monitoring plan. Analytical results of the sampling activities will be properly documented and maintained.*

Comment 5. We also note that there are two plumes separated by a narrow band of a comparatively clean aquifer. We are going along with a parallel method or suggesting a parallel method that the THE Committee recommended that these two plumes be treated simultaneously, because there is some probability of additional groundwater flow paths that just were not accounted for in that original numerical model.

Response: *Groundwater chemical data from at least seven monitoring wells (W3-6, W3-21, W3-24, WU5-3, WU5-4, WU5-6, and WU5-7) and four HydroPunch samples (CPTU5-13, -17, -18, and -31) indicate that two, separate contaminant plumes are present at OU5. The fact that the ratios of contaminants within the two OU5 plumes are distinctly different further supports the division of the plume areas. The Navy believes that the data at OU5 are adequate to move forward in selecting the cleanup technology. Additional data to confirm chemical concentrations and subsurface sediment distribution may be collected during the remedial design to optimize system effectiveness.*

Comment 6. The fourth interest is that the City of Sunnyvale would like to continually be involved in the decision making process regarding any mitigation or cleanup of OU5.

Response: *The Navy supports and encourages continued public participation during the remedial design stage through the Moffett RAB, by individual citizens, or by interested groups. The Navy will continue to inform the RAB of progress through the remedial design and remedial action implementation in accordance with EPA and DoD guidance.*

DEPARTMENT OF THE NAVY
ENGINEERING FIELD ACTIVITY, WEST
NAVAL FACILITIES ENGINEERING COMMAND
900 COMMODORE DRIVE
SAN BRUNO, CALIFORNIA 94066-5006

IN REPLY REFER TO :

5090
Ser 1843.1/L6284
1 Jul 1996

Mr. Michael Gill
U.S. Environmental Protection Agency
Region 9, Mail Stop H-9-2
75 Hawthorne Street
San Francisco, California 94105

SUBJ: RECORD OF DECISION FOR OPERABLE UNIT 5 AT MOFFETT FEDERAL AIRFIELD

Dear Mr. Gill:

Enclosed please find two copies of the Final Operable Unit 5 Record of Decision. By copy of this letter, copies have been also sent to other regulatory agencies and appropriate project personnel.

If you have any questions or comments, please call me at (415) 244-2563.

Sincerely,

STEPHEN G. CHAO
BRAC Environmental Coordinator
By direction of
the Commanding Officer

Encl: Final Operable Unit 5 Record of Decision

Copies to
U.S. Environmental Protection Agency (Attn: Ms. Elizabeth Adams) (w/o enclosure)
Dept. of Toxic Substances Control (Attn: Mr. Joseph Chou) (2 copies)
Regional Water Quality Control Board (Attn: Mr. Michael Rochette)
Nat'l. Aeronautics & Space Administration (Attn: Ms. Sandy Olliges)
Harding, Lawson Associates (Attn: Dr. James McClure)
MHB (Attn: Mr. Peter Strauss)
Mr. Bob Moss, RAB Co-Chair
URS (Attn: Mr. Kenneth Eichstaedt)
SAIC (Attn: Ms. Lynda Nicholson)
SVTC, Mr. Ted Smith (w/o enclosure)
Ratheon (Attn: Ms. Ingrid Chen)

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Ser 1843.1/L6284
1 July 1996

SUBJ: RECORD OF DECISION FOR OPERABLE UNIT 5 AT MOFFETT FEDERAL AIRFIELD

Smith (Attn: Mr. Dennis Curran)
Schlumberger (Attn: Mr. V. Thomas Jones)
RAB THE Sub-Committee (c/o Dr. James McClure) (5 copies)